

Chapter 4

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Greater scaup pair

Environmental Consequences

Introduction

This chapter describes the environmental consequences we predict from implementing the refuge management alternatives presented in chapter 3. Where detailed information is available, we present a scientific and analytic comparison between alternatives and their anticipated consequences, which we describe as “impacts” or “effects.” Where we are lacking detailed information, we make comparisons based on our professional judgment and experience. We specifically predict the effects of implementing the management actions and strategies for each of the three alternatives: Alternative A—Current Management, which serves as the baseline for comparing Alternative B—Emphasis on Tidal Wetlands and Waterfowl (Service-preferred Alternative), and Alternative C—Emphasis on Tidal Wetlands and Forest Habitat.

We focus our discussion on the impacts associated with the goals and key issues identified in chapter 1 —“Purpose and Need for Action.” Direct, indirect, short-term, beneficial and adverse effects likely to occur over the 15-year life span of the plan are discussed. Beyond the 15-year planning horizon, we give a more speculative description of the direct, indirect, and cumulative effects. Table 4.1 summarizes the effects predicted for each alternative and allows for a side-by-side comparison. Finally, this chapter identifies cumulative impacts, any irreversible and irretrievable commitment of resources, and the relationship between short-term uses of the environment and its long-term productivity.

As required by the Council on Environmental Quality (CEQ) and U.S. Fish and Wildlife Service (Service) regulations implementing the National Environmental Policy Act (NEPA), we assessed the importance of the effects of the CCP alternatives based on their context and intensity. The context of the impacts ranges from site-specific to broader regional and eco-regional scales. Although refuge lands comprise a small percentage of these larger regional area contexts, all alternatives were developed to contribute towards conservation goals in these larger contexts. The proposed species and habitat actions are consistent with the State, Regional, Ecosystem, and watershed conservation plans identified in chapter 1. At varying levels, each of the alternatives would make positive contributions to these larger landscape-scale conservation endeavors.

Impact Contexts at Eastern Neck Refuge

- Moist Soil Management Units – 4 to 20 acres
- Green Tree Reservoir–5 to 12 acres
- Individual Crop Field–1 to 33 acres
- Forest Stand–15 to 75 acres
- Eastern Neck NWR–2,286 acres (3.6 mi²)
- Lower Chester River Basin: 82,245 acres (129 mi²)
- Kent County, MD–194,300 acres (304 mi²)
- Atlantic Coast Joint Venture (ACJV) Chester River & Kent County Bayshore focus area–275,348 acres (430 mi²)
- Partners in Flight (PIF)- Landbird Conservation Plan Physiographic Region 44 (Mid Atlantic–13,891,658 acres (21,700 mi²) 5,621,877 ha
- Bird Conservation Region (BCR) 30–24,428,000 acres (38,170 mi²)

We evaluated the intensity of impacts based on the expected degree or percentage of resource change from current conditions, the frequency and duration of the effect, the sensitivity of the resource to such an effect or the natural resiliency of the resource to recover from such an effect, and the potential for implementing effective preventative or mitigation measures to reduce the effect. Duration of effects vary from those that would occur only once for a brief period of time during the 15-year planning horizon, for example, the effects of road construction, to those that would occur every day during a given season of the year, for example, impacts from hunting or fishing.

The following set of management activities are not analyzed in detail in this document because they would qualify for categorical exclusion under applicable regulations if independently proposed, and are both trivial in effect and common to all alternatives:

- Environmental education and interpretation programs (unless major construction is involved)
- Research, resource inventories, and other resource information collection activities
- Operations and maintenance of existing infrastructure and facilities (unless major renovation is involved)
- Routine, recurring management activities and improvements
- Small construction projects (e.g. fences, berms, small water control structures, interpretative kiosks, development of access for routine management purposes)
- Vegetation plantings
- Reintroduction of native plants and animals
- Minor changes in amounts or types of public use
- Issuance of new or revised management plans when only minor changes are planned
- Law enforcement activities

We describe in chapter 3—“Alternatives Considered Including the Service-preferred Alternative,” under “Additional NEPA Analysis” those actions that are not categorically excluded, but we feel are analyzed in enough detail in this document to comply with NEPA. Examples include developing a habitat management plan (HMP), activities associated with cropland, MSU, grassland, forest and wetlands habitat management programs, invasive plant control, visitor service program enhancements and new facilities, and research, inventories and monitoring.

One project which is not analyzed in enough detail to comply with NEPA is the proposal to design and construct a new breakwater project. Additional analysis and public involvement would be pursued once a lead agency and detailed proposed action are identified.

We have organized this chapter by major resource heading so that each section describes the impacts of all management activities proposed under each of the three alternatives that would likely have an effect on a given resource, for example air quality or waterfowl. Under each heading, we discuss the resource context and the types of benefits and adverse impacts of management actions that we evaluated. We then discuss the benefits and adverse effects that would occur regardless of which alternative is selected and the benefits and adverse effects of each of the alternatives.

Regional Scale Impacts: Air Quality Impacts

Chapter 2, “Affected Environment,” presents the status of air quality in the Eastern Neck refuge region. Overall air quality in the area of the refuge is currently good, although concerns with certain EPA criteria pollutants can arise periodically. The EPA reports (2007) that Kent County, Maryland, as recently as 2003, was in non-attainment for the criteria air pollutant ozone (1-hour and 8-hour). Monitoring from 2004 to 2007 shows ozone levels are now just below the 1-hour and 8-hour exceedance standards although monitoring in 2006 showed 2 days where the Air Quality Index for ozone was considered unhealthy for sensitive subgroups. Kent County is in attainment for all other criteria air pollutants. Regarding non-criteria pollutants, the county also contributes to levels of a number of the 188 EPA-monitored hazardous air pollutants (HAPS) with a 1999 estimate of 1,061,800 total pounds of emissions from all sources in the county. About 166,000 pounds were from on-road mobile sources, including automobiles, trucks, buses, and motorcycles. At around 733,000 pounds, the largest source of emissions was non-road mobile emissions such as aircraft, non-road vehicles, and commercial marine vessels (EPA, 2004).

We evaluated the management actions proposed under the three alternatives for their potential to help improve air quality, locally and regionally. The benefits we considered included:

- Potential to adopt energy efficient practices to reduce the refuge’s contribution to emissions
- Potential of refuge habitat management activities to contribute to carbon sequestration and reduce greenhouse gases

The potential adverse air quality effects of the management alternatives that were evaluated included increases in pollutants from:

- Prescribed burning for grassland and invasive plant management
- Herbicide applications for invasive plant control
- Dust from road construction and other construction sites
- Dust from exposed soil surfaces on crop fields, roads and trails
- Vehicle and equipment emissions
- Emissions from new or upgraded building facilities

Air Quality Impacts That Would Not Vary by Alternative

Overall air quality in the refuge landscape is good, with 100 percent of days reported from monitoring stations in Kent County as good or moderate in 2007. Regional air quality would not be adversely affected by refuge management activities regardless of which management alternative is selected. None of the alternatives would violate EPA standards; all three would be in compliance with the Clean Air Act.

Visibility concerns due to emission-caused haze at the nearest Class I airshed – Brigantine Wilderness Area in New Jersey would not be affected by any of the proposed management alternatives. Management actions and public uses at the refuge under all alternatives would contribute a negligible increment to the overall Kent County, or greater regional, air emissions levels. The largest possible source of emissions from refuge management activities is from prescribed fire. Fire management will be carried out under burn prescriptions which direct smoke away from the Class I Brigantine Wilderness Area.

There would be no major stationary or mobile sources of air pollutants at the refuge created under any of the refuge management alternatives. On the contrary, the Service limits public uses of the refuge to compatible wildlife-oriented activities and thus curtails man-made sources of emissions by maintaining at least 75% of refuge areas in natural vegetative cover. The analysis of air quality impacts considered only how the Service's actions at the refuge might affect criteria air pollutants, visibility, and global warming to a minimal degree, focusing on the potential for localized air quality impacts or improvement.

While emissions from heating and cooling, and from visitor and employee travel, will contribute new sources of air pollution, those impacts can be reduced through use of energy efficient systems and vehicles. We have a solar power array at one refuge facility to supply some of its electricity requirements. With our current facilities and vehicles, we have implemented actions such as installing e-glass windows, cork flooring, fluorescent lighting, motion-activated night lighting, and on-demand hot water heaters. All refuge boats are equipped with 4-cycle engines to reduce oil and gas emissions into the air and water.

We do not expect visitors traveling in motor vehicles will add measurably to current emissions. We will attempt to keep vehicle use on the refuge to a minimum and will encourage use of non-motorized trails for wildlife observation and other compatible recreational activities. Although we do provide access to motorized watercraft at certain locations, our primary water-based public use is for non-motorized canoes and kayaks.

Grasslands would be burned to maintain their health and vigor. We also intend to use prescribed fire to control 100% of *Phragmites* where they inhibit native plant growth, where fire hazards need to be reduced, or in any area where water level and wildlife habitat is adversely affected due to *Phragmites* growth. Target control is based on specific situations. Effective control of *Phragmites* would be accomplished by burning during the November to March period subsequent to herbicide applications of imazapyr or glyphosate. Prescribed burning would also be used as one method to control mile-a-minute and eliminate Canada thistle.

The major pollutants from prescribed burning are particulates (small particles of ash, partly consumed fuel, and liquid droplets), and gases including carbon monoxide, carbon dioxide, hydrocarbons, and small quantities of nitrogen oxides. These will occur to lesser and greater extents based timing, fuel loading, or whether or not other control measures were also implemented. The primary effect on air quality resulting from burning would be particulate matter emissions that result in visible smoke. Particulate emissions limit visibility, absorb harmful gases, and can aggravate respiratory conditions in sensitive individuals (Johansen et al., 1985). Smoke production is directly related to the amount of fuel consumed. Burning technique and efficiency of combustion also influence the amount of smoke produced.

Visibility and clean air are important natural resource values on the refuge and the protection of these resources would be given full consideration in fire management planning and operations. We would comply with all applicable Federal, state, and local air pollution requirements, as specified within Section 118 of the Clean Air Act, as amended (42 USC 7418). In addition, further guidance can be found in the Fire Management Handbook (USFWS, 2001). The plan stipulates required conditions under which prescribed fires would occur, to control its size, to minimize or eliminate impacts on visibility, and to reduce the potential for adding particulates and pollutants into the air created by the

burning. All the required conditions are geared to minimize smoke emissions and follow Best Available Control Technology.

“Individual prescribed burn plans would specify conditions required for burning that would minimize impacts to air quality from prescribed fire. For example, burning would not be initiated if the Maryland Department of the Environment (through Clean Air Partners) Air Quality Index for the burn day is forecasted to be Unhealthy or Very Unhealthy. In most cases required atmospheric conditions would include wind direction to direct smoke away from homes and communities, minimum mixing height of 750 feet, and minimum transport wind speed of 4 miles or knots per hour. A daily spot forecast would be obtained from the National Weather Service to evaluate forecasted atmospheric conditions.”

Although there would be transitory adverse effects on air quality resulting from our prescribed fire program, the pollution-filtering benefits derived from maintaining these areas in natural vegetation conditions would continue for the long term. Carbon emissions from all prescribed burns at the refuge would constitute a negligible increment in greenhouse gas emissions.

Air quality may be at some minimal risk of being indirectly affected by Service activities from leaks or spill accidents involving chemicals or petroleum products used in refuge management operations. However, our leak and spill prevention and emergency clean-up procedures should ensure that such occurrences are rare and are addressed immediately, with short-term effects limited to the immediate location.

Alternative A. Current Management

Benefits

There would be continuing benefits to air quality under alternative A from maintaining the natural vegetation on more than 800 acres of refuge land and 858.8 acres of tidal marsh. The air quality benefits are twofold. Natural vegetation serves to filter air pollutants and maintaining the refuge lands precludes development and the introduction of attendant sources of pollutant emissions on the land. Trees also serve as long-term carbon “sinks” that reduce the atmospheric carbon (sequestration) that causes global warming. Under alternative A, energy efficient practices would be continued and additional practices adapted as feasible. There would be some benefit from protecting 708.1 acres of forest land in terms of maintaining its contribution to carbon sequestration. This beneficial effect would be somewhat more limited in contrast to alternatives B and C that would further expand the acreage of forested land.

Adverse Impacts

There would be impacts from the annual prescribed burning of up to 30.7 acres of grassland, up to 200 acres of *Phragmites* dominated acres, and up to 100 acres of other invasive plant species. However, these respective acreages would not be burned simultaneously, thereby reducing emissions from the potential aggregate totals. The refuge’s burning prescription would include the measures previously mentioned to disperse the particulates and smoke generated from burning. Prescribed burning would also be conducted with wind directions that would carry the emissions away from residences, roadways, and smoke-sensitive facilities. Therefore, prescribed burns would be short-term events generating particulate emissions, but expected to have minimal adverse impact on air quality.

Ongoing trail maintenance activities would cause negligible short-term, localized effects from dust and vehicle and equipment exhausts. Continued operation of the refuge facilities would continue to contribute slightly to local stationary source emissions. Vehicles and equipment used by staff and co-op farmer would

contribute some negligible amount to local mobile source air emissions and particulate. Increased annual refuge visitor use levels would slightly increase vehicle emissions on refuge lands in the longer term. These localized increases from refuge activities would be negligible compared to current off-refuge contributions to pollutant levels and likely increases in air emissions in the Kent County airshed from land development over the next 15 years. Refuge activities would be more than offset by the benefits of maintaining the refuge in natural vegetation.

Alternative B. Focus on Service Trust Resources (Service-Preferred Alternative)

Benefits

As in alternative A, there would be continuing benefits to air quality from the natural vegetation on approximately 1,100 acres of refuge land and 858.8 acres of tidal marsh. Benefits from forest cover would be incrementally higher because there would be a 185.2 acre increase in forested land, and an increase in 107.8 acres of restored tidal marsh over what exists today.

Adverse Impacts

There would be slightly higher impacts than discussed under alternative A from annual prescribed burning on up to 40.3 acres of grassland, up to 300 acres of *Phragmites* dominated acres, and up to 200 acres of other invasive plants. Separate burn schedules and adherence to the favorable wind and mixing height factors noted under alternative A would mitigate these effects so the adverse impacts at any one time would remain minimal.

Ongoing trail maintenance activities would cause negligible short-term, localized effects from dust and vehicle and equipment exhausts. Continued operation of the refuge facilities would contribute slightly to local stationary source emissions. Also, because staffing would increase by up to 3 permanent employees, we predict that refuge visitation would increase by up to 15% and the associated increase of vehicle use by both staff and visitor, and increased equipment use by staff, alternative B would contribute some minimal additional increment to local mobile source air emissions.

Alternative C. Emphasis on Tidal Wetlands and Forest Habitat

Benefits

As in alternatives A and B, there would be continuing benefits to air quality under alternative C from maintaining natural vegetation on 1,300 acres of refuge land and 858.8 acres of tidal marsh. Benefits from forest cover would be highest among the alternatives because there would be a 469 acre increase in forested land from the current forest cover. Similar to alternative B, we propose an increase of 107.8 acres of restored tidal marsh. Elimination of crop production would eliminate emission sources and dust from farming vehicles and equipment. Elimination of grassland management under this alternative would mean 30.7 reduced acres requiring burning on the refuge.

Adverse Impacts

There would be impacts from prescribed burning to control invasive plants, but over the long-term, this would be limited to the portion of the refuge where invasive plant species comprise 90 percent of the vegetation cover or where tree regeneration is impacted due to the presence of invasive plants. In the short term, however, we would continue to control *Phragmites* as a priority on up to 300 acres/year, and treat other invasive plants species on up to 200 additional acres/year. Because visitor numbers would increase slightly greater than alternative B, and staffing would be the same as that alternative, the combined increased vehicle use, and equipment use by staff, would both contribute some minor additional increment to local mobile source air emissions compared to alternative B.

Regional Scale Impacts: Water Quality and Aquatic Biota

Good water quality is essential to sustaining healthy ecosystems on the refuge and within the Lower Chester River Basin. Water quality problems in the Basin caused by nutrient and sediment loading and chemical pollutants are a concern since they cause the deterioration of SAV beds and shallow water environments. These impacts, in turn, contribute to the decline or loss of aquatic species on the refuge and in the Basin, a major portion of the eastern Chesapeake Bay. The deterioration or loss of SAV beds is particularly concerning throughout the Bay area because many resources that depend on them (USFWS, 1991). Healthy SAV beds promote good water quality and aquatic habitat by:

- Providing food and habitat for waterfowl, fish, shellfish and invertebrates
- Adding oxygen to the water column during photosynthesis
- Filtering and trapping sediment that otherwise would bury benthic organisms and cloud the water column
- Inhibiting wave action that erodes shorelines
- Absorbing excess nutrients (which they require for growth), such as nitrogen and phosphorus, that may fuel the growth of unwanted algae in surrounding waters

Management actions proposed under the alternatives were evaluated and compared based on their potential to help maintain and improve the water quality of the Lower Chester River Basin. We evaluated the benefits of actions that would protect or restore Bay forested buffers, to restore tidal wetlands and their role in filtering water pollutants, and to otherwise maintain or improve water quality including:

- Shoreline protection projects that would reduce the rate of island erosion and protect SAV
- Retention of bayside buffers
- Improved water quality monitoring for early problem identification

We evaluated and compared the impacts of the refuge's management actions with the potential to cause adverse effects to water quality including the:

- Extent of farming of island croplands that might contribute to nutrient pollution
- Use of herbicides to manage grasslands or invasive species
- Refuge construction projects
- Changes in recreational use that might lead to contamination with petroleum products

Water Quality and Aquatic Biota Impacts That Would Not Vary by Alternative

Regardless of alternative implemented, none of the proposed actions would cause direct adverse impacts to water quality, or to shallow water environments, SAV beds and aquatic species in the vicinity of the refuge or elsewhere in the Bay. Rather, our management practices on the refuge and our projects partnering with local communities and other conservation agencies and organizations would continue to benefit water quality.

Checking nest boxes on
the refuge



Jonathan Priddy/USFWS

Clean water is a critical and essential resource value on the refuge and its protection would be given full consideration in management planning and operations. We would comply with all applicable Federal, state, and local water quality requirements, as specified within Sections 305(b) and 319 of the Clean Water Act, 33 U.S.C. § 1251 *et seq* as amended. All of the alternatives propose protection measures to insure management activities would not cause a decline in water quality, either on refuge lands or in the Basin.

Benefits

Refuge lands would continue to benefit water quality in the Basin by excluding development in this portion of the watershed and sustaining natural water filtering vegetation, maintaining forested bay buffers, serving as a demonstration area for best management practices to protect water quality for the Bay region, and partnering for water quality improvements and tidal marsh restoration.

Adverse Impacts

There is a negligible risk to water quality and aquatic biota that petroleum products used in staff or visitor vehicles or other chemicals used in daily operations at the refuge would adversely affect water quality or harm aquatic species in the tidal marsh or in wetlands within the refuge. Risks from the use of selected low-toxicity chemical herbicides for *Phragmites* control are also low. Risks from the use of other herbicides for control of terrestrial invasive plants are low because precautions would be taken to keep them out of any wetlands. While some potential risk exists from the increased visitor activities and numbers that we are predicting, we believe these will be negligible when managed properly. Fishing, crabbing, and wildlife observation activities that have the highest likelihood of impacting water quality and aquatic biota over the long-term, so our outreach and enforcement programs will be focused here. Research studies in aquatic habitats would include stipulations to minimize impacts to these resources.

Contaminants from routine operations: In managing the refuge, we would closely monitor and mitigate all of our routine activities that have some potential to result in chemical contamination of water directly through leakage, spills or indirectly through soil runoff. These include control of weeds and insects around structures, use of chemicals for deicing roads and walkways, and use of soaps and detergents for cleaning vehicles and equipment. Refuge staff will take the following precautions to minimize the potential for the chemicals and petroleum products becoming a water quality problem:

- Pouring or mixing of chemicals or petroleum products will be conducted no closer than 25 feet to surface water and over a non-porous surface material
- Obtain training in spill prevention and spill response

Our leak and spill prevention and emergency clean-up procedures should ensure that such occurrences are rare and are addressed immediately, with short-term effects limited to the immediate location.

Wetland invasive plant control with herbicides: Regardless of the alternative selected, the herbicide active ingredient glyphosate, used in a formulation such as Rodeo® known to have low aquatic toxicity, and the herbicide active ingredient imazapyr, used in the brand-name formulation Habitat®, would be used as one method to control *Phragmites* in the refuge tidal marsh. Herbicides that would be used to control other invasive plant species on the refuge would not be used

for *Phragmites* control and do not pose a direct risk to water quality or aquatic species. Those herbicides are reviewed in the “Soils” section of this chapter. The Regional Contaminants Specialist, who is responsible for upholding Federal standards for water quality and soil protection, must review proposals and approve all use of chemical herbicides on refuge lands.

Glyphosate Effects on Aquatic Species: In some formulations, such as the one in the brand name formula Rodeo®, glyphosate is not a problem aquatic contaminant because it does not contain the toxic adjuvant (auxiliary chemical) that is found in other formulations, such as in the brand name formula Roundup. It is also quickly adsorbed to suspended soil particles in water, making it rapidly biologically unavailable. There would be some potential for herbicide concentrations in sediments and backwaters to build up over time. The potential depends on the balance of herbicide input and removal from the aquatic system. Herbicide inputs may occur either through direct application, water inflow, or through resuspension and diffusion from the sediment layer. Herbicide removal from the system may occur through outflow, degradation, volatilization, and settling or diffusion into the underlying sediment (Neitsch et al., 2001).

The rate of herbicide degradation is an important consideration for assessing the effects of a given herbicide on aquatic systems. Glyphosate degrades with a reported half-life in water that ranges from 3.5 to 70 days depending on the rate of transfer to the sediment layer and testing source (USFS, 1996). Based on the relatively short half-life and the large flux in water volume of the tidal marshes, it is not expected that any greater than negligible effects would occur as a result of herbicide treatments.

According to a Forest Service risk assessment glyphosate in less toxic formulations appears to have a very low potential to cause any adverse effects in aquatic animals (USFS, 2003). The use of less toxic formulations results in hazard quotients that do not approach a level of concern for any species. Nevertheless, use of glyphosate near bodies of water where sensitive species of fish may be found should be conducted with substantial care to avoid contamination of surface water. The likelihood of direct acute toxic effects on aquatic invertebrates or longer term direct effects on any fish species seems extremely remote based on central estimates of the hazard quotient and unlikely base on upper ranges of the hazard quotient (USFS, 2003).

Aquatic plants appear to be somewhat less sensitive to glyphosate than the most sensitive aquatic animals. There is no indication that adverse effects on aquatic plants are plausible. Unlike the case with aquatic animals, even short-term toxicity studies in aquatic plants use endpoints involving changes in population density (USFS, 2003).

Imazapyr Effects on Aquatic Species: According to the Forest Service risk assessment, imazapyr appears to have a very low potential to cause any adverse effects in aquatic animals (USFS, 2004). Modeled concentrations of imazapyr in ambient water over prolonged periods of time are estimated to be no greater than 0.00045 mg/L and peak concentration of imazapyr associated with runoff or percolation are estimated to be no more than 0.036 mg/L. Monitoring data from a field application similar to those that may be used in Forest Service programs was used as the basis for the peak concentrations that might be expected. All of the hazard quotients for aquatic animals are extremely low. Thus, there is no basis for asserting that effects on nontarget aquatic species are plausible. The highest hazard quotient of 0.01 is below the level of concern at the typical application rate (LOC=1.0) by a factor of 100 and below the level of concern at the highest application rate (LOC=0.36) by a factor of 36. In the case of an accidental

spill of a large amount of imazapyr into a relatively small body of water, mortality in sensitive species of fish is plausible. Actual concentrations in the water after a spill would depend on the amount of compound spilled and the size of the water body into which it is spilled (USFS, 2004).

Aquatic plants, particularly macrophytes, are much more sensitive than aquatic animals to imazapyr exposure. For aquatic macrophytes, the upper range of the hazard quotient for peak concentrations ($HQ=3$) is above the level of concern by a factor of 3 at the typical application rate ($LOC=1$) and a factor of about 8 at the highest application rate ($LOC=0.36$, $3 \div 0.36=8.3$). Thus, under foreseeable worst case conditions, acute effects could be seen in aquatic macrophytes. Longer term concentrations of imazapyr, however, result in hazard quotients for macrophytes that are well below a level of concern. Hazard quotients for sensitive species of unicellular algae are below a level of concern based either on peak concentration of imazapyr in water (a hazard quotient of 0.02 at the upper range of exposure) as well as longer term concentrations that might be expected (hazard quotient of 0.003 at the upper range of exposure). Thus, at both the typical application rate ($LOC=1$) and the maximum application rate ($LOC=0.36$), the upper ranges of the hazard quotients for sensitive species of algae are substantially below the level of concern. Accidental spills of large quantities of imazapyr into relatively small bodies of water could lead to much higher concentrations—i.e., 3 mg/L to 4 mg/L. After spills of this magnitude, adverse effects on aquatic plants could be anticipated from imazapyr in both macrophytes and sensitive species of algae.

Terrestrial Invasive Plant Control with Herbicides: There is some slight risk that herbicides used for invasive plant control other than *Phragmites* may reach the tidal marsh and affect water quality or harm aquatic species. Most herbicides proposed for use are nontoxic or of low toxicity to aquatic species.

Aminopyralid (Trade Name: Milestone): This herbicide is usually applied in broadcast or spot treatments with backpack sprayers and skid sprayers. In aquatic systems, the primary route of degradation is photolysis (decomposition by light), where a laboratory experiment yielded a half-life of 0.6 days. Aminopyralid was stable to direct hydrolysis and in anaerobic sediment-water systems. In aerobic sediment-water systems, degradation occurs slowly, with observed total system half-lives of 462 to 990 days resulting in formation of non-extractable residues and no other major products. Under aerobic conditions, degradation of aminopyralid in five different soils resulted in the production of CO₂ and non-extractable residues. Half-lives ranged from 31.5 to 533.2 days in 5 soils. For risk assessment purposes, EPA used a half-life of 103.5 days. Aminopyralid is weakly sorbed (held by absorption and/or adsorption) to soil. Two field dissipation studies performed in California and Mississippi indicate that aminopyralid is likely to be non-persistent and relatively immobile in the field. Half-lives of 32 and 20 days were determined, with minimal leaching below the 15 to 30 cm soil depth. Aminopyralid has been shown to be practically nontoxic to birds, fish, honeybees, earthworms, and aquatic invertebrates. Aminopyralid is slightly toxic to eastern oyster, algae and aquatic vascular plants. Aminopyralid is not expected to bioaccumulate in fish tissue. There are no acute or chronic risks to fish or aquatic invertebrates, algae or aquatic plants (USFS, 2007).

Clopyralid (Trade Name: Transline) is usually applied in broadcast or spot treatments with backpacks or skid sprayer. Its bioconcentration potential is low, but its potential for soil mobility is very high, therefore it cannot be applied to open water or where runoff may occur. It has high potential to leach into groundwater under certain soil conditions. Photolysis half-life in water is 261 days and in soil is > 12 years. Under aerobic soil conditions the half-life is 71 days. It is practically nontoxic to aquatic organisms (USFS, 2004). Clopyralid is degraded by soil microbes, with an estimated half-life of 14 to 29 days, meaning

that one-half of the amount applied remains in the soils after 90 days, one-fourth of the applied amount remains after 28 to 58 days, one-eighth after 42 to 87 days, and so on. Increased soil moisture decreases degradation time. Clopyralid is weakly adsorbed and has moderate leaching potential. Modeling results indicate clopyralid runoff is highest in clay soils with peaks after rainfall events. Clopyralid percolation is highest in sandy loam soils (SERA, 1999a; Herbicide Handbook, 2002).

2,4-D acid and amine salts have been found to be practically nontoxic to freshwater or marine fish. The 2,4-D esters have been found to be highly toxic to fish. The chronic toxicity endpoint for the acid and amines salts is based on larval length and survival, and the chronic endpoint for the esters is based on fish survival. Acute toxicity studies on 2,4-D acid and amine salts show these compounds to be slightly toxic to practically nontoxic to aquatic invertebrates. The 2,4-D esters have been found to be very highly toxic to slightly toxic to freshwater and marine invertebrates. The 2,4-D esters may be chronically toxic to freshwater and marine invertebrates. 2,4-D is toxic to aquatic plants; it is more toxic to vascular plants than to non-vascular plants. (USEPA, 2005)

Imazapic (Trade Names: Journey, Plateau) is applied in broadcast and spot treatments with backpack and skid sprayers. Aquatic animals appear to be relatively insensitive to imazapic exposures, with LC values of >100 mg/L for both acute toxicity and reproductive effects. Aquatic macrophytes may be much more sensitive, with an acute EC of 6.1g/L in duck weed (*Lemna gibba*). Aquatic algae appear to be much less sensitive, with EC values of greater than 45 g/L. Imazapic does not appear to be very toxic to aquatic fish or invertebrates. The weight of evidence suggests that no adverse effects in fish or aquatic invertebrates are plausible using typical or worst-case exposure assumptions at the typical application rate of 0.1 lb/acre or the maximum application rate of 0.1875 lb/acre. (USFS, 2004)

Metsulfuron methyl (Trade Name: Escort) is applied in broadcast or spot treatments with backpacks or skid sprayers. It cannot be applied to open water or where runoff may occur. It percolates in sandy soils and may run off on clay soils. It degrades in soil, with a variable half-life of 120 days (USFS, 2007). The chemical has very low toxicity to aquatic organisms. 96-hour LC50 values are greater than 150 mg/l in rainbow trout and bluegill. Forty-eight hour toxicity tests with the freshwater invertebrate *Daphnia magna* resulted in a LC50 of greater than 150 mg/l (40). A 21-day life-cycle test with *Daphnia magna* also exhibited very low toxicity. The NOEL for survival and reproduction was >150 mg/l (EXTOXNET, 1996).

Nicosulfuron (Trade Name: Accent) is applied in broadcast and spot treatments with backpack and skid sprayers, and boom sprayers. Nicosulfuron is practically nontoxic to freshwater fish and invertebrates. The 96 hour LC50 for bluegill and rainbow trout is >1,000 mg/L. The 48 hour EC50 for *Daphnia magna* is >1,000 mg/L; Nicosulfuron has an acute contact toxicity LD50 >20 µg/bee and an acute dietary LC50 >1000 ppm. It is considered practically nontoxic to honey bees. Biodegradation is an important degradation mechanism for nicosulfuron. The half-life of nicosulfuron in a silt clay soil is 26 days. However, anaerobic conditions slow down the degradation process. The half-life of nicosulfuron in silt clay soil/water is 63 days. Nicosulfuron is very mobile in sandy loam and silt loam soils. The formulated product Accent has a photolysis half-life of 60-67 days in soil. Field dissipation half-life of the same material was 3 weeks at pH 6.5, 7 weeks at pH 7.4, and 2 weeks at pH 8. Accent poses minimal risk of leaching to groundwater. The soil-binding characteristics and values place the herbicide in EPA's classification of low to intermediate soil mobility. The formulated product Accent has a photolysis half-life of 14-19 days in water with a pH of 5, 200-250

days at a pH of 7, and 180-200 days at a pH of 9. The hydrolysis half-life of the same material is 15 days at a pH of 5. (EXTOXNET, 1995)

Triclopyr (Trade Name: Garlon) is applied in broadcast, spot treatment, cut stump and basal treatments with backpack and skid sprayers. It cannot be applied to open water or where runoff may occur. It is relatively nontoxic to terrestrial vertebrates and invertebrates, but can be extremely toxic to fish and aquatic invertebrates. For this reason, we use it only as a basal or cut stump application directly on the base of trees and do not use it as a broadcast spray. In soils, it is degraded by photolysis, microbial metabolism, and hydrolysis to the parent compound, triclopyr acid. Triclopyr acid has an intermediate adsorption potential, limiting movement of the acid in the environment. The acid degrades with an average half-life of 30 days. The ester formulation is not water-soluble and can take significantly longer to degrade in water (TNC, 2007).

Fishing and Crabbing: Anticipated impacts to water quality and aquatic biota from fishing and crabbing are expected to be minimal. Although fishing and crabbing causes direct mortality to fish and crabs, season dates and limits are set with the long-term health of populations in mind. Populations of most species are regularly monitored by state agencies and have determined that a controlled sport fishing harvest would not adversely affect overall fish population levels. There are no anticipated long-term impacts of this use as long as fish and crab populations continue to be monitored by the State.

Research: Aquatic habitats and biota may also be impacted by research. Sampling activities may cause soil compaction and the trampling of vegetation near waterways. The establishment of temporary foot trails and boat trails through aquatic vegetation beds, disruption of bottom sediments, and minor vegetation damage when equipment is temporarily placed is possible. The removal of vegetation or sediments by core sampling methods may cause increased localized turbidity and disrupt non-target plants and animals. Installation of posts, equipment platforms, collection devices and other research equipment in open water may present a hazard if said items are not adequately marked and/or removed at appropriate times or upon completion of the project. Negligible vehicle emissions, contaminants from vehicle fluids and very minor erosion from roads may result from vehicle access to the research sites. To minimize the potential for impacts, all research projects will operate under a special use permit, with stipulations as warranted to insure planned activities would not impact aquatic resources. As new and innovative techniques become available, we would encourage researchers to use the least intrusive research methodologies and techniques.

Alternative A. Current Management

Benefits

There would be continued benefits to shallow water habitats, SAV, and aquatic species from protection of the tidal marsh vegetation and native plant communities on the refuge uplands which filter runoff from cropland and other operations on the refuge. Sediment basins and best management farming practices also minimize the potential for nutrient and contaminant flows into the surrounding shallow water.

Adverse Impacts

Extensive shoreline protection measures are not proposed under alternative A. As the unprotected portions of the refuge marsh and uplands continue to be converted to shallow water through shoreline erosion, there would be a net increase in aquatic habitat. However, the habitat would be of lower value than the habitats that now surround the island. While the island persists, erosion

and the associated sediment load would continue to negatively affect aquatic resources and the habitats they depend upon. In the much longer term, as the island continues to erode, the major predicted environmental consequence to aquatic resources would likely be the loss of the SAV beds in the shallow waters surrounding the island in the lower Chester River Basin. Of particular concern are the extensive waterfowl resources, which depend on these beds.

Under alternative A, there would be a minimal level of risk of herbicide used in invasive plant control contaminating shallow water habitats. Up to 200 acres of treatment for *Phragmites* is planned. Any potential risk would be mitigated through proper application procedures, and because we would use only aquatic certified herbicides approved by the Regional Contaminants Coordinator. Herbicide use has occurred on the refuge for many years without any accidental spills or detectable non-target impacts.

Cooperative farming would continue on 557.1 acres, but using best management farming practices would help minimize adverse impacts. Only historical croplands would be cultivated. No drainage systems would be created, and the actions used to minimize and mitigate runoff and erosion would result in very minor, if any, impacts on water quality and shallow water habitats in the Basin and Bay. Best management practices would continue to be used in our cropland management program to minimize chemical, as well as sediment and nutrient runoff. These practices include limited use of herbicides, coupled with the use of sediment basins, crop rotations, use of cover crops, no-till planting, utilization of grassy waterways and field borders, and use of nitrogen-fixing and weed controlling crops to minimize the need for additional chemicals.

Under alternative A, fishing, hunting, and non-consumptive uses, including hiking, wildlife photography, canoeing and kayaking would increase by approximately 10% over the next 15 years from current levels based on our predictions and regional recreational trend information. This presents an increased potential for contamination through runoff of petroleum products from roads and parking areas and through litter. Staff would remain observant of risks and would minimize threats where possible. In particular, littering would be an enforcement priority.

Alternative B. Emphasis on Tidal Wetlands and Waterfowl (Service-Preferred Alternative)

Benefits

Compared to alternative A, there would be increased benefits to water quality, shallow water habitats, SAV, and aquatic species from protection of the tidal marsh vegetation and native plant communities on the refuge uplands because we would implement beneficial shoreline protection and cropland management practices.

Shoreline protection is the highest priority for management, with up to 107.8 acres of restored tidal marsh planned. Protecting our current tidal marsh and restoring additional tidal marsh would buffer the erosive forces of runoff and tides and reduce turbidity that adversely affects water quality for fish and invertebrates. With turbidity reduced, more sunlight can penetrate the water column facilitating SAV growth. Additionally, a decrease in turbidity will lessen sedimentation which may bury bottom-growing plants and invertebrates. Protecting native upland vegetation also reduces upland erosion and sedimentation/ turbidity effects.

Cropland operations would be reduced 185.2 acres from the current 557.1 acres to 371.9 acres, thereby reducing the potential for contamination from field runoff by one-third. Many of those former croplands would be managed as forest or other

natural habitat, which provides a more effective water filtering capability. On cropland fields we would continue to implement the best management practices noted under alternative A to minimize the potential for nutrient and contaminant flows into the surrounding shallow water. We also would more actively engage in efforts with refuge partners to address water quality issues and restore shallow water habitats in the Basin.

Adverse Impacts

During construction of the proposed breakwaters, temporary adverse impacts associated with additional turbidity would be expected. Long-term turbidity would be significantly reduced, benefiting aquatic resources and aquatic habitats. Construction and its resulting disturbance would cause the temporary relocation of aquatic resources and the permanent displacement of some species within the footprint of fill material and structures. The use of stone breakwaters would provide hard surfaces as an additional habitat type for epiphytic attachment. Because projects would be designed to protect and restore SAV, we expect overall beneficial consequences for aquatic resources in alternative B.

Shrub and tree clearing and road removal, realignment, and construction activities associated with crop field consolidation and relocation of the refuge headquarters access road would increase the potential for sedimentation and turbidity in adjacent marsh and shallow waters from erosion of exposed soils. Because these activities would not be conducted immediately adjacent to the shoreline, the potential for these impacts to occur would be low. Proper site preparation and use of standard mitigation practices such as silt fences would further limit any potential for impacts.

Under alternative B, we would likely increase the acreage treated with herbicide for grassland management or invasive plant control so there would be a minor increased risk for herbicide to contaminate shallow water and SAV habitats. This is based on the proposal to treat up to 300 acres of *Phragmites* and up to 200 acres of other invasive plants on refuge lands.

Under alternative B, fishing, hiking, wildlife photography, canoeing and kayaking would likely increase by up to 15% from current levels. This presents a slightly increased potential above alternative A for contamination of the surrounding shallow water through runoff of petroleum products from roads and parking areas. Similar to alternative A, refuge staff would minimize threats to water quality and actively enforce against littering.

Alternative C. Emphasis on Tidal Wetlands and Forest Habitat

Benefits

Alternative C would have the same long term benefits of breakwater construction as described for alternative B.

Under alternative C, cropland operations would be eliminated from the current 557.1 acres, thereby eliminating the potential for herbicide contamination in crop field runoff. These former croplands would be managed as forest habitat, which provides the most effective water filtering capability. We also would engage more actively in efforts with refuge partners to address water quality issues and restore shallow water habitats in the Basin.

Under alternative C, we would also eliminate the 30.7 grassland acres treated with herbicide and reduce invasive plant control to areas where they comprise 90% dominant cover or where tree regeneration is being negatively impacted. As a result, there would be a corresponding decreased risk for herbicide contamination of shallow water and SAV habitats.

Observing birds on
the refuge



Jonathan Priddy/USFWS

Regional Scale Impacts: Socioeconomic Impacts

Adverse Impacts

Alternative C would have the same short-term adverse impacts of breakwater construction as described for alternative B.

We would continue to control invasive plants with herbicides on up to 300 acres of *Phragmites* and up to 200 acres of other invasive plants. Some of these same acres would be treated with prescribed burning as well. Over the long term, the need for treatment would be reduced in the uplands as native forest becomes established. In the short term, these treatments would have some minimal potential to affect water quality as discussed above.

Under alternative C, fishing and hunting activities as well as non-consumptive uses, including hiking, wildlife photography, canoeing and kayaking would likely increase up to 20% from current levels. This presents a slightly increased potential above alternatives A and B for contamination of the surrounding shallow water through runoff of petroleum products from roads and parking areas and litter.

We evaluated socioeconomic impacts in terms of the degree to which the proposed alternatives might affect the local economy, social structures, or quality of life of the local communities and Kent and Queen Anne's counties, Maryland.

To evaluate potential benefits or adverse effects to the local economy from each alternative, we considered changes in:

- Jobs and income to the local community from changes in refuge staffing
- Jobs and income from jobs in temporary construction work on the refuge
- Local income and production from changes in cropland management
- Expenditures into the local economy from changes in public uses of the refuge
- Expenditures into the regional economy from changes in waterfowl hunting in the Lower Chester River Basin

We considered the Service's Division of Economics (FWSDE, 2007) estimates of the economic effects of recreation visits to the refuge in terms of generating employment, income, tax revenue, and final demand in an analysis area defined by the economies of Kent and Queen Anne's counties. Combined, these factors represent the full "multiplier" effect of initial spending on recreation-related goods and services plus succeeding rounds of spending internal to the local area economy. The two-county economic effects were derived using the IMPLAN economic model with estimated refuge recreational use of 103,946 visits in 2006 comprised of 42,766 local area resident visits and 61,180 non-resident visits. Those visits were estimated to generate \$2.7 million in expenditures, 92 percent of which (\$2.5 million) related to non-consumptive uses. Non-residents accounted for \$2.3 million of all expenditures (85 percent). Those expenditures had an economic effect of generating \$3.8 million of final demand (through the multiplier effect) in the combined county economies, with \$1.2 million in job income based on 44 direct and induced jobs. Taxes generated by these expenditures would be in the form of personal income taxes and indirectly in personal property taxes since neither Kent nor Queen Anne's counties have a corporate taxes or sales tax. Income taxes would accrue to the counties, State, and Federal governments. However, the study did not indicate what percentage would accrue to the counties so this attribute was not further considered.

Additional relevant statistics that were factored into the analysis were the most recently available detailed economic statistics on business revenues, payroll, and jobs for Kent and Queen Anne's counties. Kent County had \$597 million in sales in 2002 with \$115 million in payroll to employees of those businesses which included a minimum estimated 5,044 jobs. Queen Anne's county had \$1,128 million in sales in 2002 with \$155 million in payroll to employees of those businesses which included a minimum estimated 7,760 jobs. Combined sales were \$1.7 billion; combined payroll \$270 million based on a combined 12,800 jobs. Those figures would have increased in 2007 based on corresponding income and population growth in both counties.

The \$2.7 million in final demand comprises 0.16 percent of the total expenditures for goods and services in the two counties with an assumed roughly similar ratio of total final demand to recreation induced demand. The \$1.1 million in job income comprises approximately 0.75 percent of the total job income and the 44 jobs 0.34 percent of the total jobs in the two counties. Therefore, there would most likely be a measurable but minimal impact on these local economies from any increase or decrease of recreational expenditures at the refuge. Because activities at the refuge are more closely connected to the town of Rock Hall and nearby smaller communities, the economic effects would likely be somewhat increased, but still minor in this smaller local economy, as compared to the larger two-county context. Local impacts are discussed under the alternatives below. Certain economic sectors, specifically agriculture, would also be affected in a similar way because of the agricultural activity involved in cooperative farming at the refuge.

**Socioeconomic Impacts
That Would Not Vary by
Alternative**

Regardless of which alternative we select, we would continue to make revenue sharing payments to Kent County. The amount of payment is determined by Congress each year; however, these revenue sharing payments would have only a negligible effect on the county budget. We do not make revenue sharing payments to Queen Anne's County because no refuge lands occur in that county. Non-resident visitors to the refuge (approximately 59% of the 103,946 estimated visitors) would continue to spend some money in Queen Anne's County on their way to and from the refuge, thereby benefiting that economy.

**Alternative A. Current
Management**

Benefits

Maintaining our continuing role as the most important sanctuary and food source for migrating and wintering waterfowl in the Lower Chester River Basin will help sustain the economic values of waterfowl hunting on Maryland's Upper Eastern Shore. The refuge is one of the most important tourist attractions on the Eastern Shore. Refuge visitation and associated ecotourism revenue contribute annually to the local economy. An estimated 55,000 visitors annually come to the refuge to view wildlife, particularly waterfowl. Waterfowl populations seeking sanctuary and forage at the refuge also directly affect the leasing of hunting rights on nearby private lands. According to the most recent National Survey of Fishing, Hunting, and Wildlife-Associated Recreation (USFWS, 2005), an estimated 43,000 waterfowl hunters in Maryland in 2001 spent more than \$10 million on food and lodging, transportation, and equipment to pursue their sport. These expenditures generated \$15.6 million in economic output and \$5.9 million in job income to the 149 resulting jobs. State taxes of \$1.1 million and Federal taxes of \$1.6 million were also generated. Some portion of these economic benefits can be attributed to waterfowlers hunting in or near the Lower Chester River Basin and harvesting ducks and geese sustained in part by the refuge. In alternative A, waterfowl use of the refuge would be expected to be maintained as we protect and manage the tidal marsh and maintain croplands to provide a high quality waterfowl forage during winter. Consequently, visitation and its

contribution to the local economy can be expected to be maintained as well as the economic benefits from waterfowl hunting.

The local economy would continue to benefit minimally from recreationist expenditures for fishing, crabbing, deer hunting and youth turkey hunting on the refuge; from wildlife observation and photography; and from visitor participation in interpretation and education programs. These benefits would materialize by way of visitor expenditures for auto fuel, meals, fishing, crabbing and hunting gear, binoculars and other wildlife equipment purchases, though many of these latter purchases would likely be made outside the local area.

We would also continue to contribute to the local economy of Rock Hall and nearby small communities near the refuge in terms of refuge staff jobs, income, and expenditures. We would also contribute to the local economy minimally in terms of cooperative farming jobs, income, and expenditures because we will continue cooperative farming operations on 557.1 acres. A small amount of corn production will continue to enter the local agriculture market but will have a no effect on the size or prices of the market. These effects on local jobs, personal income, spending-induced final demand and the agricultural markets would further diminish in importance if considered in the context of the greater Kent County economy or the combined Kent and Queen Anne's county economy.

Adverse Impacts

No substantive management changes are planned and no staffing increases are proposed under this alternative. Thus, no appreciable changes to the refuge's contribution to local economies would occur. We would likely see a minimal increase in public uses of the refuge, which we predict could be up to a 10% increase, which would minimally increase expenditures by those users in the local economy

Alternative B. Emphasis on Tidal Wetlands and Waterfowl (Service-Preferred Alternative)

Benefits

Cropland consolidation would improve our ability to maintain the benefits of our role as sanctuary and food source for migrating and wintering waterfowl in the Lower Chester River Basin and better sustain the economic values of waterfowl hunting on the Upper Eastern Shore.

Enhanced participation in partnering to protect water quality, SAV beds, and shallow water environments in the Basin would help to better sustain migrating and wintering waterfowl and contribute to successful waterfowl hunting as well as wildlife observation. Our actions on the refuge to consolidate the most productive cropland fields, enhancing the quality, quantity, and availability of forage in those fields, constructing additional MSU's and improving MSU and GTR management on the refuge would increase the use of the refuge by geese and ducks. This too would contribute to increased economic benefits of sustained waterfowl populations in the Basin. There would also be increased observation opportunities on and off the refuge benefiting the local economy in terms of expenditures for food, lodging, transportation and equipment.

Adding refuge staff will minimally increase benefits to the local economy in jobs, income, and demand. Road realignment construction work and work to upgrade refuge management infrastructure would also add expenditures to the local economy for labor, materials, and services.

Expanding refuge programs would increase public use and public involvement in refuge activities thereby increasing their expenditures and the resulting jobs and income in the local economy. Enhancing existing infrastructure would provide

higher quality experiences for such activities as fishing and crabbing. Improved refuge programs would also attract more visitors. We estimate up to a 15% increase in visitation over current levels. The local economy would experience minimally increased benefits in terms of retail expenditures for purchasing fishing and crabbing bait and tackle, auto fuel, and related expenses in the Rock Hall local economy. These increases would be minimal compared to the overall expenditures on these factors in the local economy.

Adverse Impacts

Reducing cooperative farming from 557.1 to 371.9 acres would negligibly reduce demand for agricultural inputs (e.g. seed, fertilizer, herbicides, etc) in the local market. The proposed changes in strategies under alternative B for implementing the farming program in the future would have variable, but negligible effects locally. A change in the crop split to 25-refuge: 75-farmer would reduce the farm produce contribution to the local market. Requiring 100 percent of the crop be left in the field would remove the crop entirely from the local market while leaving the cooperative farming job and expenditures for equipment and materials intact. Conducting all farm operations by force account would eliminate the farm job in the local economy but equipment and materials expenditures would still be made. None of these changes should make any but a minimal impact in the local economy.

Alternative C. Emphasis on Tidal Wetlands and Forest Habitat

Benefits

Eliminating refuge croplands would substantially reduce our ability to provide sanctuary and food for migrating and wintering geese and some duck species. The economic values of waterfowl hunting on the Upper Eastern Shore would be adversely affected although the value as a sanctuary to other waterfowl in the Lower Chester River Basin would be maintained.

Similar to alternative B, adding refuge staff under alternative C would minimally increase benefits to the local economy in jobs, income, and expenditures. Road realignment construction work and work to upgrade refuge management infrastructure would also add expenditures to the local economy for labor, materials, and services.

Expanding refuge programs would increase public use and public involvement in refuge activities thereby increasing their expenditures and resulting jobs and

income in the local economy. Extending the Tundra Swan Boardwalk north and adding a car top boat launch to the south end of the island, would allow more fishing access and opportunities and likely increase fishing and crabbing activity on the refuge. The local economy would experience minimally increased benefits in terms of retail expenditures for fishing and crabbing bait and tackle, auto fuel, and related expenses. These increases would be minimal, however, compared to the other contributors to the overall local economy.

Adverse Impacts

Eliminating cropland production entirely on the refuge would remove its contributing benefits of jobs and expenditures for materials and equipment from the local economy. While the impact would be negligible on the local economy, its impact would much greater felt on the cooperative farmer who would lose all his income generated from refuge activities.

Wetlands on the refuge



Jonathan Priddy/USFWS

Refuge-Specific Impacts: Shoreline Impacts

We evaluated impacts to shoreline based on whether refuge management actions would help reduce the rate of shoreline erosion and limit human activities that have the potential to cause increased shoreline erosion.

Factors that would benefit shoreline protection include:

- Maintenance of existing shoreline protection
- Extent of additional shoreline protection projects
- Maintaining a forested shoreline vegetated buffer
- Protecting and restoring tidal marsh habitat

Factors that may adversely affect the refuge shoreline:

- Degree to which public access to the shoreline of the refuge might increase erosion
- Management activities on the refuge have the potential to increase shoreline erosion

Shoreline Impacts That Would Not Vary by Alternative

Benefits

Regardless of which alternative we select, we would continue to maintain the off-shore breakwaters and on-shore armoring that currently protects a large portion of the refuge's western shoreline. We would also continue to maintain the vegetated shoreline buffers that reduce erosion caused by wind and wave action. We would continue work with partners to restore tidal marsh which also effectively reduces wave impacts to shoreline.

Adverse Impacts

Under all the alternatives, there is some minimal potential that refuge visitors might cause localized shoreline erosion. We would continue to permit fishing and crabbing access from the Entrance Bridge, Tundra Swan Boardwalk, Boxes Point Trail, Duck Inn Trail, Ingleside Recreation Area, and Bogle's Wharf. We would continue to restrict public access to these designated areas to avoid shoreline impacts in any other locations. Canoeists and kayakers would have the use of the water trail under all alternatives and would be instructed to not land their craft anywhere along the refuge shoreline to avoid causing impacts.

Alternative A. Current Management

Benefits

Although we do not propose the expanded shoreline protection projects under this alternative that we do in alternatives B and C, we would continue to voice our concerns about shoreline protection through partners and the media and respond to partner efforts to implement shoreline protection as funding and material sources become available to them.

Adverse Impacts

This alternative provides the most limited opportunity to actively pursue and implement shoreline protection projects because we would be entirely dependent on other entities to initiate those efforts and could not quickly respond to erosion threats at any particular locations along the refuge shoreline.

There would continue to be a limited potential for refuge visitors to go off designated trails or shoreline recreation sites and enter restricted parts of the refuge where they might inadvertently cause damage to the shoreline and locally accelerate erosion. We will continue to educate the public to our concerns

about this issue and address any instances of unauthorized entry that we might encounter.

Alternative B. Emphasis on Tidal Wetlands and Waterfowl (Service-Preferred Alternative)

Benefits

Under alternative B we would expand our shoreline protection over the next 15 years with three proposed breakwater projects providing approximately 25,000 feet of additional breakwaters on the refuge's southern and southeastern shores. Measures to protect shoreline and tidal marsh are identified in alternative B as the highest management priorities to implement.

Adverse Impacts

Because refuge public use under alternative B would likely increase compared to alternative A, there would be a somewhat increased potential for members of the public gaining unauthorized access to unprotected sections of shoreline either from land or in watercraft. In these instances there might be some minor damage to protective vegetation that could hasten localized erosion, but monitoring of shoreline proposed under this alternative would likely locate and lead to measure to address this damage before any substantive effects result.

Alternative C. Emphasis on Tidal Wetlands and Forest Habitat

Benefits

The same benefits would accrue under this alternative from the expanded breakwater projects as described for alternative B. Allowing upland areas to succeed to forest cover would minimize the potential for access to unauthorized sections of the shoreline from the land side.

Adverse Impacts

As in alternative B, because refuge public use would likely increase under alternative C, there would be a slightly increased potential for members of the public gaining unauthorized access to unprotected sections of shoreline either from the land side or in watercraft. Impacts would be similar to alternative B.

Refuge-Specific Impacts: Tidal Marsh Impacts

The Service currently manages about 858.8 acres of tidal marsh and 60.5 acres of open water on the refuge. The open water often occurs as pockets in the tidal marsh. Less than 15 acres of permanent open water exists on the refuge's uplands. We evaluated the benefits and adverse impacts of the management actions under the three CCP alternatives on these tidal wetlands. We considered the benefits from

- Protecting and restoring tidal marsh habitat
- Maintaining a forested shoreline buffer
- Treating invasive species

We considered the potential adverse impacts of

- Wetlands habitat management activities
- Upland habitat management activities
- Visitor facility, road and trail construction and maintenance
- Public consumptive and non-consumptive refuge uses

Tidal Marsh Impacts That Would Not Vary by Alternative

Benefits

The tidal marsh is as important as the shoreline protection projects in terms of maintaining the integrity of the refuge because it buffers the erosive effects of

tides and wave action. It also serves as reproductive habitat for fish, shellfish, and other aquatic species as well as marsh birds. And, it also provides a protective cover for migrating and wintering waterfowl. Regardless of the management alternative we select, we would continue to conserve these wetlands and the wildlife they support as one of our highest priorities.

Adverse Impacts

The refuge would continue to support and manage compatible uses, such as fishing, that has the potential to affect the tidal marsh and associated species, with the commitment to also monitor those activities to insure they remain compatible and result in minimal impacts. Discarded fishing line and other fishing litter can entangle migratory birds and mammals and cause injury and death (Gregory, 1991). Additionally, litter impacts the visual experience of refuge visitors (Marion and Lime, 1986). Law enforcement issues related to fishing include littering, illegal trespass and fires. We believe that given proper management, fishing would not result in any short or long-term impacts that would adversely affect the purpose of the refuge or the mission of the Refuge System.

Alternative A. Current Management

Benefits

Continued management of the tidal marsh under alternative A would continue to conserve the values discussed above, though improvements in management and protection of these wetland areas would be limited. We would manage approximately 858.8 acres of tidal marsh and another 60.5 acres of open water. Management would include treating invasive *Phragmites*, and working with volunteers and partners to restore the marsh to native species to the extent feasible based on staff and funding. We would also continue to maintain the breakwater and on-shore armoring projects that currently protect refuge shoreline.

Adverse Impacts

There would be negligible direct impacts to the tidal marsh currently managed by the Service on the refuge under alternative A. The current acreage would be maintained and a minimal amount of additional acreage within the refuge boundary would be restored within current breakwater projects, although we would be limited in our efforts to promote these efforts under this alternative. There would be no alteration of these habitats by cutting, filling, or other means to achieve any other Service goals.

The tidal marsh may be at some minimal risk of being indirectly affected by Service activities in upland areas that drain into them from leaks or spill accidents involving chemicals or petroleum products used in refuge management operations. Our leak and spill prevention and emergency clean-up procedures should ensure that such occurrences are rare and are addressed immediately, with short-term effects limited to the immediate location.

Increased refuge visitation would likely result in greater impact to tidal areas since these are a popular destination on the refuge. We would continue to maintain existing designated access point and monitor impacts in restored areas to insure adverse impacts are kept to a minimum area.

Alternative B. Emphasis on Tidal Wetlands and Waterfowl (Service-Preferred Alternative)

Benefits

We would substantively increase benefits to the tidal marsh habitat and marsh-dependant species under alternative B as compared to alternative A. First, we would expand our shoreline protection projects to protect approximately 25,000 additional feet of shoreline, thereby reducing the erosive forces of tides and waves that also tend to erode the refuge marsh. Second, we would actively restore up to

107.8 acres of tidal marsh in the areas protected by these projects. Our reduced cropland farming program would reduce the potential risk of spills or runoff by one-third.

Adverse Impacts

There would be negligible direct impacts to the emergent wetlands and forested wetlands currently managed by the Service on the refuge under alternative B. The impacts of maintaining and improving existing facilities near the water would be short-term, localized turbidity and some minimal loss of wetlands plants, but no substantive habitat alteration or degradation would occur. Impacts to wildlife from discarded fishing line and litter would still occur to some degree but would be mitigated under this alternative with implementation of our Monofilament Recovery and Recycling Program at the refuge fishing areas. The increased visitation predicted has the potential to create additional impact, but we would be vigilant in monitoring that use and concentration areas to insure this is kept to a minimum.

As with alternative A, chemical or oil leak and spill prevention and emergency clean-up procedures should ensure that such occurrences are rare and are addressed immediately, with effects limited to the immediate location.

Alternative C. Emphasis on Tidal Wetlands and Forest Habitat

Volunteer clean-up on the refuge



Jonathan Priddy/USFWS

Benefits

Benefits would be similar to those discussed for alternative B. We would substantively increase benefits to the tidal marsh habitat and marsh-dependant species as compared to alternative A, by expanding our shoreline protection projects to protect approximately 25,000 additional feet of shoreline and actively restoring up to 107.8 additional acres of tidal marsh in the areas protected by these projects.

BMPs practiced for forest management would limit the potential for runoff of chemical fertilizers and herbicides. Nevertheless, there remains some minimal risk that these materials might reach the tidal marsh either in locations where runoff is not fully captured in the forested buffer zones or through adsorption to windborne dust. Under alternative C, the potential risk to tidal marsh from chemical or oil spills or runoff from refuge management activities is much reduced over the other alternatives primarily because there would be no cropland management program.

Adverse Impacts

The impacts described under alternative B would be the same for alternative C, except those associated with cropland management. Alternative C would not include that program.

Refuge-Specific Impacts: Soils Impacts

Soils are the structural matrix and nutrient source for plant productivity and must be protected to sustain the variety of wetland, riparian, and upland habitats that would meet refuge habitat and species management goals. Overall, the soils of the refuge are productive and in good condition, with little or no compaction or contamination problems. However, certain areas, particularly the shorelines, are experiencing erosion and are susceptible to disturbance. We would attempt to manage these areas to minimize human disturbance and to mitigate for natural processes that result in loss of valuable habitats, particularly at bald eagle sites.

We evaluated and compared the management actions proposed for each of the refuge CCP alternatives on the basis of their potential to benefit or adversely affect refuge soils.

We considered the benefits from:

- Protection of soils from conversion to impervious surfaces or restoration of disturbed sites
- Enhancement of soils formerly in agricultural production through re-establishment of native vegetation;
- Reduction of erosion along interior water courses and refuge shorelines;

We considered the potential adverse impacts to soils from:

- Construction of buildings, parking facilities, access roads, and interpretive trails
- Habitat management activities, including cropland management and new MSU construction to benefit wintering waterfowl and other migratory birds
- Refuge visitor activities

Soils Impacts That Would Not Vary by Alternative

Benefits

The soils of the refuge are in good condition and would remain so under all management alternatives. We would continue to maintain the refuge protective vegetative cover that minimizes soil losses through erosion. We would continue to prohibit recreational activities such as ATVs or mountain biking, that would damage soils on the refuge. Hiking trails, boat launch sites, wildlife observation areas, parking areas and other high-use areas would continue to be well maintained to keep soil effects to a minimum. Any erosion problems will be noted during routine refuge monitoring and corrected as soon as feasible.

Regardless of which alternative we select, we would continue to use best management practices in all management activities that might affect refuge soils to ensure that we maintain soil productivity. Site conditions including soil composition, condition and hydrology will be the ultimate determinant of the management potential for any particular site on the refuge. No site would be managed in a manner inconsistent with its recognized potential.

In general, no soil from off-site will be brought onto the refuge unless, as may be the case in creating new MSUs, bringing in clean soil is determined to be less disturbing to refuge resources for building up a small levee than scalping the soil on site.

There may be small projects where cut and fill may occur on a project. Whenever feasible, however, we will conduct soil restoration on degraded sites to natural topography and hydrologic conditions and we will return these sites to native vegetation as quickly as feasible.

Adverse Impacts

There is a potential for adverse impacts from the management tools we propose to use at varying scales under all alternatives to help maintain, enhance or create wildlife habitat. These tools include replanting with native species, prescribed burning, mowing, and herbicides. Soils in the upland areas could be affected by trail, boat launch, parking lot or other maintenance or construction projects. Soils in the MSUs would be affected only by the management actions taken to enhance these more intensively managed areas for waterfowl, shorebirds, and other species, or by restoration of these areas to their natural status under alternative C.

Prescribed Fire: Prescribed fire would be used under all alternatives for invasive plant control and under alternatives A and B for grassland management as well. All such fires would be conducted under a strict prescription and under optimal weather conditions to minimize smoke concerns and risk of wildfire. We would strive to maintain all fires within prescription to minimize resource degradation although impacts could occur in small areas.

Prescribed fire elevates surface temperatures; mineralizes detritus, litter and standing dead material; volatilizes some nutrients and organic matter; alters soil water-holding capacity; and alters populations of soil micro- and macro-fauna (Barbour et al., 1999). The effects on organic matter depend on the intensity and duration of fire. Intense, long duration fires consume more organic matter than brief, low intensity fires. Nitrogen compounds volatilize and are lost at temperatures of 100-200 °C; in contrast, calcium, sodium, and magnesium are usually deposited on the soil surface and recycled. At temperatures of 200-300 °C, large amounts of organic substances are lost, which can reduce the cation exchange and moisture holding capacity of soils.

Fire usually elevates soil pH, as a result of cation release; the effect is particularly evident in acidic soils. Soil microbial nitrogen fixation may be enhanced following fire, due to mineralization of nutrients and elevated pH levels in soils (Barbour et al., 1999). Removal of litter and duff may initially facilitate water infiltration; nevertheless, evaporation is also mediated by loss of litter and blackened soils. This results in an overall reduction in the water-holding capacity of soils. There is little change in water repellency with cool fires (below 176 °C); moderately hot fires increase water repellence (176-204 °C). Extremely hot fires (above 204 °C) volatilize hydrophobic substances and destroy soil water repellence (Debano et al, 1998). After moderately intense fires, runoff may increase due to lowered infiltration, and erosion may result.

Fires usually reduce fungi, but increase soil bacteria. It may remove soil and litter pathogens. Nitrifying bacteria are often destroyed by fire. Legumes and other nitrogen-fixing plants often must recover nitrogen losses due to volatilization, as the recovery of nitrifying bacteria is slow (Barbour et al., 1999).

Our prescribed fires are carried out on a small scale, are of short duration, and are low to moderate intensity. They also consume only part of the duff/litter layer and rarely transfer significant amounts of heat into the soils. Prescribed fires remove litter and light fuels, and avoid the significant adverse effects of severe, hot wildfires on soil resources.

Herbicides: All chemical use on the refuge must first be approved through the Pesticide Use Proposal process. The Refuge Manager, Regional Pest Management Coordinator, and National Pest Management Coordinator have approval authority, depending on the chemical, application procedure, and whether the application is in a wetland or upland location. We primarily use herbicides for invasive species control, although some herbicides continue to be used as part of our cooperative farming program. The following list of herbicides and their potential effects on soils and water is derived mainly from the products' labels and material safety data sheets, except where noted. The active ingredient is followed by the primary target plant/method of application, and impacts:

Aminopyralid (Trade Name: Milestone) is usually applied in broadcast or spot treatments with backpack sprayers and skid sprayers. In aquatic systems, the primary route of degradation is photolysis, where a laboratory experiment yielded a half-life of 0.6 days. Aminopyralid was stable to direct hydrolysis and in anaerobic sediment-water systems. In aerobic sediment-water systems,

degradation proceeds slowly, with observed total system half-lives of 462 to 990 days resulting in formation of non-extractable residues and no other major products. Under aerobic conditions, degradation of aminopyralid in five different soils resulted in the production of CO₂ and non-extractable residues. Half-lives ranged from 31.5 to 533.2 days in 5 soils. For risk assessment purposes, EPA used a half-life of 103.5 days. Aminopyralid is weakly absorbed to soil. Two field dissipation studies performed in California and Mississippi indicate that aminopyralid is likely to be non-persistent and relatively immobile in the field. Half-lives of 32 and 20 days were determined, with minimal leaching below the 15 to 30 cm soil depth. Aminopyralid has been shown to be practically nontoxic to birds, fish, honeybees, earthworms, and aquatic invertebrates. Aminopyralid is slightly toxic to eastern oyster, algae and aquatic vascular plants. The log K_{ow} is less than 3 and thus aminopyralid is not expected to bioaccumulate in fish tissue. There are no acute or chronic risks to non-target endangered or non-endangered fish, birds, wild mammals, terrestrial and aquatic invertebrates, algae or aquatic plants (USFS, 2007).

Clpyralid (Trade Name: Transline) is usually applied in broadcast or spot treatments with backpacks or skid sprayer. Its bioconcentration potential is low, but its potential for soil mobility is very high therefore it cannot be applied to open water or where runoff may occur. It has high potential to leach into groundwater under certain soil conditions. Photolysis half-life in water is 261 days and in soil is > 12 years. Under aerobic soil conditions the half-life is 71 days. It is practically nontoxic to aquatic organisms. (USFS, 2004) Studies of clopyralid effects on soil invertebrates have been conducted, including field studies on the effects to microorganisms. Soil concentrations from USDA Forest Service applications are expected to be 1,000 less than concentrations that would cause toxic effects. Therefore, no effects to soil invertebrates or microorganisms are expected from use of clopyralid (SERA, 1999a). Clopyralid is degraded by soil microbes, with an estimated half-life of 14 to 29 days, meaning that one-half of the amount applied remains in the soils after 90 days, one-fourth of the applied amount remains after 28 to 58 days, one-eighth after 42 to 87 days, and so on. Increased soil moisture decreases degradation time. Clopyralid is weakly adsorbed and has moderate leaching potential. Modeling results indicate clopyralid runoff is highest in clay soils with peaks after rainfall events. Clopyralid percolation is highest in sandy loam soils (SERA, 1999a; Herbicide Handbook, 2002).

2,4-Dichlorophenoxyacetic Acid (Trade Name: 2,4-D) is used in broadcast or spot treatments with backpack and skid sprayers. 2,4-D is considered to be moderately to practically nontoxic to birds on an acute basis. The avian chronic endpoint is based on the endpoints of eggs cracked and decreased number of eggs laid. 2,4-D is classified as slightly toxic to small mammals on an acute oral basis. The mammalian chronic endpoint is based on decreased maternal body weight gain and changes in hematology. A honey bee acute toxicity study indicated that 2,4-D is practically nontoxic to the honey bee. 2,4-D is toxic to terrestrial plants; it is more toxic to dicots than to monocots. The EPA conducted a screening level ecological risk assessment to determine the potential impact of 2,4-D use on non-target terrestrial and aquatic organisms. The Agency used modeling to evaluate ecological risks for 2,4-D. Most ecological risk quotient (RQ) values exceed the LOC, with the following exceptions: chronic risk to fish from use of 2,4-D BEE for aquatic weed control, risk to endangered aquatic plants from use of 2,4-D on rice and for aquatic weed control, chronic risk to mammals from use of 2,4-D liquid spray, acute risk to non-endangered and endangered plants from use of 2,4-D liquid spray, and acute risk to non-endangered and endangered plants from use of 2,4-D granules. As noted in the ecological risk characterization, many of the assumptions used in the ecological risk assessment are conservative,

and risk to many non-target organisms may be overestimated. The Agency's screening level risk assessment for 2,4-D concluded that there is a potential for risk to endangered species. Reductions in application rates and/or number of applications will reduce overall risk. The turf rate will be reduced from 2.0 lb/acre per application to 1.5 lbs a.e./acre per year. The spray drift control measures are expected to reduce the risk of 2,4-D to non-target plants (USEPA, 2005).

Diflufenzopyr (Trade Name: Overdrive) is used in broadcast or spot treatments with backpack sprayer and skid sprayers. Results of biotransformation studies using a loam soil under aerobic conditions indicate that diflufenzopyr will be non persistent and under anaerobic conditions indicate that diflufenzopyr is expected to be slightly persistent under anaerobic aquatic conditions. For biotic transformation in the terrestrial environment, diflufenzopyr was not persistent under aerobic soil conditions. For biotic transformation in the aquatic environment, diflufenzopyr was slightly persistent under aerobic aquatic conditions (McEwan and Stephenson 1979). Major transient transformation products M1 and M9 were detected at a maximum of 16% of the applied radioactivity, and were not expected to persist in the aquatic environment. Under anaerobic aquatic conditions, diflufenzopyr was slightly persistent (McEwan and Stephenson 1979). Of the two major transformation products that were formed, M1 was transient and M9 persisted in water. (PMRA 2005) Diflufenzopyr is practically nontoxic on an acute basis to avian species ($LD_{50} > 2250$ mg a.e./kg; $LC_{50} > 5620$ ppm a.i.), of low acute toxicity to small mammals ($LD_{50} = 4000$ mg/kg) and practically nontoxic to honey bees ($LD_{50} > 25$ μ g a.e./bee). Diflufenzopyr is slightly toxic to practically nontoxic to freshwater organisms ($LC_{50} = 15$ to > 135 ppm a.e.). Diflufenzopyr is slightly toxic to practically nontoxic to estuarine/marine organisms (LC_{50} or $EC_{50} = 18.9$ to > 138 ppm a.e.). Diflufenzopyr is highly toxic to terrestrial plants. Seedling emergence studies identified the turnip as the most sensitive dicot species ($EC_{25} = 0.0008$ pounds acid equivalent/acre) and ryegrass as the most sensitive monocot (Shoot Length $EC_{25} = 0.0055$ lbs. a.e./A) (USEPA 1999).

Glyphosate (Trade Name: Rodeo, Round-up, Glypro) is sprayed aerially via helicopter, or applied in broadcast or spot treatment with backpacks or skid sprayer. It is degraded by microbial action in both soil and water, and degrades in soil with an estimated half-life of 30 days. It is highly soluble, but adsorbs rapidly and tightly to soil (USFS, 2003). Numerous soil bacteria, fungi, invertebrates, and other microorganisms have been studied for effects of glyphosate application. There is nothing to suggest glyphosate would adversely affect soil organisms. Glyphosate is readily metabolized by soil microorganisms and some species can use glyphosate as a sole source of carbon (SERA, 2003b). Sylvia and Jarstfer (1997) found that after 3 years, pine trees in plots with grassy weeds had 75 percent fewer mycorrhizal root tips than plots that had been treated 3 times per year with a mixture of glyphosate and metsulfuron methyl to remove weeds. Glyphosate degrades in soil, with an estimated half-life of 30 days. Glyphosate is highly soluble, but adsorbs rapidly and tightly to soil. Glyphosate has low leaching potential because it binds so tightly to soil. Modeling results indicate glyphosate runoff is highest in loam soils with peaks after the first rainfall (SERA, 2003b; Herbicide Handbook, 2002).

Imazapic is a relatively new herbicide, and there are no studies on the effects of imazapic on either soil invertebrates or soil microorganisms. If imazapic was extremely toxic to soil microorganisms, it is reasonable to assume that secondary signs of injury to microbial populations would have been reported (SERA, 2001a). Imazapic degrades in soil, with a half-life of about 113 days. Half-life is decreased by the presence of microflora. Imazapic is primarily degraded by microbes and it does not degrade appreciably under anaerobic conditions. Imazapic is weakly

adsorbed in high soil pH, but adsorption increases with lower pH (acidic soils) and increasing clay and organic matter content. Field studies indicate that imazapic remains in the top 12 to 18 inches of soil and do not indicate any potential for imazapic to move with surface water. Modeling results indicate imazapic runoff is highest in clay and loam soils with peaks after the first rainfall. Imazapic percolation is highest in sandy soils (SERA, 2001a; Herbicide Handbook, 2002).

Imazapyr (Trade Names: Arsenal, Habitat) There are no studies on the effects of imazapyr on soil invertebrates, and incomplete information on the effects on soil microorganisms. One study indicates cellulose decomposition, a function of soil microorganisms, can be decreased by soil concentrations higher than concentrations expected from USDA Forest Service applications.

There is no basis for asserting adverse effects to soil microorganisms (SERA, 1999b). Degradation rates are highly dependent on microbial action. Anaerobic conditions slow degradation. Imazapyr is weakly bound to soil, but adsorption increases with lower pH and increasing clay and organic matter content. Adsorption increases with time as soil dries and is reversible. Field studies indicate that imazapyr remains in the top 20 inches of soil and do not indicate any potential for imazapyr to move with surface water. In forest field studies, imazapyr did not run off and there was no evidence of lateral movement. Modeling results indicate imazapyr runoff is highest in clay and loam soils with peaks after the first rainfall. Imazapyr *percolation* is highest in sandy soils (SERA, 1999b; Herbicide Handbook, 2002).

Metsulfuron methyl (Trade Name: Escort) Studies on the effects of metsulfuron methyl on soil biota are limited to *Pseudomonas* species, though there are a few studies of insects that live in soil. The lowest observed effect concentration is 5 mg/kg, based on the *Pseudomonas* study. At recommended use rates, no effects are expected for insects. Effects to soil microorganisms appear to be transient (SERA, 2003c). Metsulfuron methyl degrades in soil, with a variable half-life up to 120 days. Half-life is decreased by the presence of organic matter though microbial degradation of metsulfuron methyl is slow. Non-microbial hydrolysis is slow at high pH but rapid at lower pH. Adsorption to soil particles, which affects the runoff potential of metsulfuron methyl, increased with increased pH and organic matter. Modeling results indicate that off-site movement due to runoff could be significant in clay soils. Metsulfuron methyl *percolates* in sandy soils (SERA, 2003c; Herbicide Handbook, 2002).

Nicosulfuron (Trade Name: Accent) is applied in broadcast and spot treatments with backpack and skid sprayers, and boom sprayers. Nicosulfuron is slightly toxic to birds on an acute and dietary basis. The oral LD50 for bobwhite quail was >2,250 mg/kg. The dietary LC50s for mallard ducks and bobwhite quail were >5,620 ppm. Nicosulfuron is practically nontoxic to freshwater fish and invertebrates. The 96 hour LC50 for bluegill and rainbow trout is >1,000 mg/L. The 48 hour EC50 for *Daphnia magna* is >1,000 mg/L. Nicosulfuron has an acute contact toxicity LD50 >20 ug/bee and an acute dietary LC50 >1000 ppm. It is considered practically nontoxic to honey bees. Biodegradation is an important degradation mechanism for nicosulfuron. The half-life of nicosulfuron in a silt clay soil is 26 days. However, anaerobic conditions slow down the degradation process. The half-life of nicosulfuron in silt clay soil/water is 63 days. Nicosulfuron is very mobile in sandy loam and silt loam soils (EXTOXNET, 1995).

Triclopyr The five commercial formulations of triclopyr contain one of two forms of triclopyr, BEE (butoxyethyl ester) or TEA (triethylamine). Triclopyr BEE is much more toxic to aquatic organisms than triclopyr TEA. A breakdown product, TCP (3,5,6-trichloro-2-pyridinol), is more toxic than either form of triclopyr. Site-

specific cumulative effects analysis buffer determinations need to consider the form of triclopyr used and the proximity of any aquatic triclopyr applications, as well as toxicity to aquatic organisms (SERA, 2003f). Triclopyr has not been studied on soil invertebrates. Soil fungi growth was inhibited at concentrations 2 to 5 times higher than concentrations expected from USDA Forest Service application rates. Triclopyr has an average half-life in soil of 46 days, while TCP has an average half-life in soil of 70 days. Warmer temperatures decrease the time to degrade triclopyr. Soil adsorption is increased as organic material increases and decreased as pH increases. Triclopyr is weakly adsorbed to soil, though adsorption varies with organic matter and clay content. Both light and microbes degrade triclopyr (SERA, 2003f; Herbicide Handbook, 2002).

Public Uses: The hunt programs for deer and turkey has the potential to cause some soil compaction since off-road and off-trail foot travel occurs. However, with hunter density of about one hunter per 20 acres throughout the hunting season, impacts would be minimal based on our observations of past hunting impacts. Refuge regulations allow only limited ATV use by non-ambulatory hunters. This use is restricted to roads and field edges. Vehicles would be confined to existing roads and parking lots. Concentrated shoreline use from visitors engaged in fishing and water access have the potential to compact soil as well. To date, this impact has been localized to small areas and we would continue to monitor that use to insure the impacts are kept to a minimum. Visitors engaged in wildlife observation, wildlife photography, interpretation and environmental education activities and programs would cause similar localized impacts in authorized use areas

Alternative A. Current Management

Benefits

Maintenance of the existing shoreline breakwater and armoring protection will prevent soils adjacent to that portion of the shoreline from being exposed and eroded away by wave and wind action.

There would be no loss or damage to soils on the upland portions of the refuge under alternative A. Maintaining the naturally vegetated portions of the refuge would continue to protect the soils in those areas. Use of no-till and cover crop rotations on the crop fields and other best management farming practices will retain soil quality on the cropland portions of the refuge.

Adverse Impacts

Soils adjacent to the currently unprotected sections of the shoreline would continue to be at risk of being exposed and eroded away due to wave and wind action. We would continue to monitor shoreline erosion and when possible through partnering establish shoreline protection in areas at high erosion risk.

We do not anticipate any significant adverse impacts on refuge soils from continuing current management using best management practices. Refuge staff would continue to use prescribed burns periodically on grassland areas to maintain grasslands or control invasive plant species. The cooperative farmer would continue to cultivate and harvest 557.1 acres of crops. Only historical croplands would be cultivated. No drainage systems would be created, and the actions used to minimize and mitigate runoff and erosion would result in very minor, if any, impacts on soils. Refuge staff would continue to mow 30.7 acres of grasslands in order to support nesting for grassland dependent birds and areas for butterflies, but would conduct that mowing under conditions that minimize compaction and soil displacement, e.g. avoiding excessively wet periods.

Visitation under alternative A is expected to increase so visitor activities that might impact soils, such as hiking off designated trails would pose a minimally

Alternative B. Emphasis on Tidal Wetlands and Waterfowl (Service-Preferred Alternative)

higher concern than at present. We would continue to monitor public use areas to determine if soil erosion may be a problem and will take steps to mitigate the problem if it occurs.

Benefits

Once crop field consolidation has been completed, the soil impacts of farming would decrease by about one-third as compared with alternative A since croplands would be reduced from 557.1 acres under alternative A to 371.9 acres under this alternative. Larger, forested blocks would replace former crop areas while forest strips are cleared and the land incorporated into the larger crop fields. Any potential for greater soil erosion that might be due to the larger crop field size would, in our professional judgment, likely be more than offset by reforestation of 185 acres of previously farmed land. Cropland soils would continue to be protected by the sustainable, best-management farming techniques we use to prevent sediment, chemical, and nutrient runoff into the Bay, including crop rotation, cover crops, no-till planting, utilization of grass waterways and field borders, and using nitrogen-fixing, weed-controlling crops to reduce the need for chemical fertilizers and herbicides.

Without protection, shoreline erosion would continue to gradually expose and wear away portions of the island soil substrate along sections of refuge shoreline. Expanded protection of the shoreline from erosion under alternative B would help prevent such incremental damage to and loss of soils adjacent to the shoreline.

Adverse Impacts

The crop field consolidation we propose under alternative B would include:

- Removal of hedgerows and forested strips adjacent to crop fields
- Preparation of the soils for cropping,
- Removal of the road surfacing on the existing headquarters access road and preparation of the soils for cropping
- Vegetation removal and realignment and surfacing of the new refuge headquarters access road

The new MSU's proposed under alternative B would include:

- Creating an earthen levee, up to approximately 1 foot high, to seasonally hold water in existing low lying areas

All of these activities would involve use of trucks and heavy equipment. Soils would be exposed during these activities and there would be compaction and erosion in some locations. Best management practices would be employed to limit any damage or loss of refuge soils in these operations. In the long-term, as noted above, soils would benefit from cropland consolidation. In creating the new MSUs, we would consider hauling in clean soil from off site to create the levees, which are expected to be less than 1 foot high, if it would be less of an impact to refuge resources, including soils and cultural resources, than scalping the soil surface on-site.

We would slightly increase annual burning to manage an additional 9.6 acres of grassland, and to control invasive plants as needed, so the risk of impacts should be somewhat higher but comparable to alternative A; that is, minimal and localized. We would continue to follow BMPs and burn prescriptions to reduce those risks to soils. We would use other management methods and equipment

that may lead to localized soil compaction and short term soil losses from erosion but would employ best management practices to ensure that no long term, major soil problems—such as unchecked erosion— result.

Increased visitation under alternative B would increase the likelihood of disturbance and compaction of soils in areas of the refuge where visitation is allowed. It would also increase the likelihood of unauthorized entry to areas where visitation is not allowed, off trails and along the shoreline where soils might be affected. Design features that factor in the potential for soils effects, monitoring of these more intensive public use areas, and effective signage and brochures to reduce entry to unauthorized areas would mitigate against any the potential for long-term impacts.

Alternative C. Emphasis on Tidal Wetlands and Forest Habitat

Benefits

Alternative C would be the most beneficial in terms of soil restoration and protection because we would eliminate all cropland and grassland management. Impacts from farm equipment, mowers, herbicides, and other site disturbances would be virtually eliminated under this alternative. Allowing these upland areas to succeed to forest vegetation would in the long term put them in the vegetative cover that would best protect soils from erosion.

Adverse Impacts

Replanting of trees to restore forest cover may cause short-term soil disturbance, compaction and localized erosion depending on site conditions and site preparation methods. These would be minimal with use of best management practices. In the long term, establishment of native species would help restore and maintain soil productivity at these sites.

Use of prescribed fire would continue for the foreseeable future to control invasive plants, especially in newly established forest habitat. We would adhere to burn prescriptions to reduce the risk of impacting soil productivity or creating areas of erosion.

Similar to alternative B, there would be some localized increase in soil impacts where public access and uses are enhanced under this alternative. Design, monitoring, and visitor information would mitigate against the potential for long-term soil impacts.

Refuge-Specific Impacts: Forest Habitat Impacts

The forest habitats of the refuge provide a diversity of habitat components to support breeding birds and other wildlife. We evaluated the benefits and adverse impacts of the management actions under the three alternatives on forest habitats.

We considered the benefits from:

- Allowing natural succession to forest cover to occur on existing grassland and cropland areas
- Controlling invasive plants

We considered the potential for adverse impacts from:

- Potential for burning or herbicides to affect forest vegetation
- Potential for invasive plants to continue to adversely affect forest vegetation

Forest Habitat Impacts That Would Not Vary by Alternative



Jonathan Priday/USFWS

Duck Inn Trailhead

Benefits

Wherever practicable, we would replace non-native plant species with native forest species capable of growing under the current site conditions to restore the ecological integrity and diversity of the refuge.

Monitoring and controlling gypsy moth populations will benefit refuge forest habitat by preventing widespread tree loss and maintaining forest health. The gypsy moth *Lymantria dispar* (L.) is a non-native invasive species. Currently there are no native controls on this population. Gypsy moths prefer oaks as a host but also feed on the foliage of many deciduous tree species found on the Eastern Shore of Maryland. Once trees are defoliated multiple times during the growing season they become stressed. The stressed trees are then extremely prone to other stressors including diseases. Death of many important oak tree species can be the ultimate result if treatment does not occur. This would have a substantial impact to many species of wildlife that rely heavily on these trees as a food source.

When gypsy moth populations increase to the level where defoliation is evident, the caterpillars can cause a substantial public nuisance, affect human health, reduce tree growth, and cause branch dieback or tree mortality. These impacts can affect the refuge's ability to meet the primary mission to protect and enhance Service trust resources and species and habitats of special concern in the Bay region and to maintain a healthy and diverse complex of natural community types comprised of native plants and animals to pass on to future generations of Americans.

The area to be treated on the refuge will vary from year to year and will be determined by aerial defoliation surveys. Only forested areas on the refuge will be sprayed. The products to be used will be species specific and will have very little or no impacts on non-target organisms. The monitoring and control of the effects of this invasive species on native wildlife fits well within the goals established by the USFS, the Service, and the refuge.

Adverse Impacts

Regardless of which alternative we select to manage the refuge, certain activities may affect forest habitat at various levels depending on the alternative:

- Prescribed fire
- Herbicides
- Refuge infrastructure maintenance and improvements (e.g. roads and trails)

The impacts of prescribed fire and herbicides were discussed previously in the section on "Soils." Both treatments would be implemented to benefit wildlife habitat using strict procedures and protocols so as not to affect non-target resources. The alternatives would vary in terms of the extent and frequency of use of these management practices.

An indirect long term impact is the potential for deer or turkey hunters in particular, because they move through major portions of the refuge, and for other refuge visitor to unintentionally introduce and/or spread invasive species. Once established, invasive plants can out-compete native plants, thereby altering habitats and impacting wildlife. The threat of invasive plant establishment will always be an issue, and will require annual monitoring, treatment and hunter and visitor education.

Alternative A. Current Management

Benefits

Under alternative A, benefits would be limited to protection of refuge lands. Priorities would continue to be maintaining forest cover as well as grasslands. Protection of the existing 708.1 acres of forested upland under this alternative would benefit the habitat through long-term Service management and conservation.

Adverse Impacts

There would continue to be some minimal level of risk of loss or damage to forest vegetation involved with use of the habitat management methods described above, particularly use of prescribed fire to reduce forest fuel loads or to maintain adjacent grasslands. Fire management Planning Guidance is provided in appendix F. The Service will adhere assiduously to detailed burn plans based on the guidance to ensure that risks to forested areas remain low. Because of its toxicity to trees, imazapyr would not be used to control *Phragmites* or other invasive plant species where there is a risk of trees being inadvertently sprayed. Herbicides would be used only under strict application precautions to ensure that only the targeted plants are affected.

Management of green tree reservoirs (GTRs) poses a risk that some trees may be killed if flooded either too early before trees go dormant or beyond the end of the dormant season. Standard refuge practice will ensure that flooding and drawdown or release of flood waters are properly timed to eliminate this risk. GTRs will also be allowed to dry for a full season periodically to ensure trees are not jeopardized.

Routine maintenance of roads and trails may result in the loss of individual trees, but we do not expect the number of trees felled would affect the quality or diversity of forest habitat present.

Alternative B. Emphasis on Tidal Wetlands and Waterfowl (Service-Preferred Alternative)

Benefits

Forested habitat would increase through Service management of 881.6 acres on the refuge under alternative B. This would primarily occur through establishment of native tree species on former croplands. Through best management forest practices and invasive plant control, we would enhance the health and vigor of these newly established stands. Over the long-term, forest habitats would result in less risk of an environmental impact from cultural and habitat management practices since less intervention would be necessary to sustain it.

Adverse Impacts

In the cropland consolidation proposed under alternative B, localized tree cutting of forested borders totaling about 17 acres would be required to consolidate adjacent smaller fields and to implement the new routing for the headquarters access road proposed. The health characteristics and habitat value of these forested field and roadside borders is not as high as the larger less disturbed forested areas of the refuge. The border areas are heavily infested with invasive plant species and there is only a limited degree of forest regeneration possible in such narrow confines. So in the long term the loss of forest habitat value when these are removed would be minimal compared to the total acreage of forest that grows and is protected under this alternative.

Alternative C. Emphasis on Tidal Wetlands and Forest Habitat

Benefits

Alternative C would provide the greatest benefits to the refuge's forest habitats compared to the other alternatives. Forested acreage would increase under alternative C by allowing earlier successional vegetation to grow into forest. Approximately 1,319.5 acres, nearly double the current cover, would eventually

be forested under this alternative, resulting in larger unbroken tracts. This expanded acreage and reduction in forest fragmentation would make the habitat more viable for migratory forest-dependent birds and other forest dwelling animals and in general increase the habitat's capability to support natural processes, biodiversity, integrity and health.

Adverse Impacts

Forest community diversity may be affected under alternative C. Allowing natural succession to proceed unimpeded may lead to dominance by one or a few tree species which may limit the diversity of forest dependent fauna on the refuge.

Refuge-Specific Impacts: Grassland Habitat Impact

The 30.7 acres of grassland habitat on the refuge provides foraging and migratory habitat for birds, and habitat for a variety of butterflies and other native wildlife. The size and configuration of grassland habitat patches, however, limits their benefits to breeding grassland birds. We evaluated the benefits and adverse impacts of the management actions under the three CCP alternatives on grassland habitats by considering the benefits from:

- Maintenance and restoration of grassland habitat
- Allowing natural succession to occur on existing grassland areas

We considered the potential for adverse impacts from:

- Mowing, prescribed fire, and herbicides to maintain grasslands
- Allowing natural succession to eliminate grassland or early successional habitats

Grassland Habitat Impacts That Would Not Vary by Alternative

Because under alternative C we propose to eliminate management of grasslands on the refuge, with the exception of the small BayScape garden, there would be no benefits or adverse impacts to grasslands that would not vary by alternative.

Alternative A. Current Management

Benefits

All refuge lands are afforded protection from development and managed with a mandate to promote wildlife habitat. Continuing to manage 30.7 acres of grasslands on the refuge would maintain the refuge's minimal role in contributing to maintaining grasslands in the eco-region and to the overall biodiversity this type represents on the refuge.

Adverse Impacts

Because of the more intensive management methods required to maintain grasslands, there would continue to be some minimal level of risk of damage to grassland soils and vegetation involved with use of mowing, burning, or herbicides to manage the habitat. Best management practices would continue to be followed for these methods. The potential for impacts to soils are discussed in a previous section. Mowing and the use of other mechanized equipment or vehicles on grassland, for example herbicide spray equipment, would be allowed only when soil moisture conditions would not result in extensive compaction or rutting. We would adhere assiduously to detailed burn plans to ensure that prescribed fire risks remain low. Herbicides would be used only under strict application precautions to ensure that only the targeted plants are affected.

Alternative B. Emphasis on Tidal Wetlands and Waterfowl (Service-Preferred Alternative)

Benefits

Approximately 40.3 acres would be managed in grassland under alternative B, an 9.6 acre increase over alternative A. This increase would provide some additional benefits to foraging and migrating birds, and for butterflies and other native

wildlife, that use this habitat type. Benefits would also be realized by refuge visitors since grasslands typically afford quality viewing areas.

Adverse Impacts

Best management practices would be followed for prescribed burns, mowing, and other practices that could impact grassland soils and cause localized habitat damage. Native species would be used to restore any damaged areas. Long term management to promote the habitat would offset any such localized short-term adverse effects.

Increased visitation might result in increased trampling or localized impact areas affecting grassland health and vigor. We would continue to advise people to stay on designated trails to minimize those impacts and monitor for effects on grasslands.

Alternative C. Emphasis on Tidal Wetlands and Forest Habitat

Benefits

Under alternative C, there would be no management for grassland habitats, except the small BayScape garden. Existing grasslands would be managed to promote their transition to forest habitat. This would reduce and eventually eliminate impacts caused by burning, mowing, or use of herbicides to maintain the grassland.

Adverse Impacts

Under alternative C, within approximately 15 years, all managed grasslands would be eliminated, although some may occur on the refuge as a result of natural disturbances. With the loss of grasslands, the existing biodiversity of the refuge would be diminished, although this is difficult to quantify. Further, the refuge's minimal contribution to sustaining grassland habitats in the eco-region would also be eliminated.

Refuge-Specific Impacts: Waterfowl Impacts

The refuge provides high quality waterfowl habitat and is a priority focus area for waterfowl management on the Upper Eastern Shore of the Chesapeake Bay in Maryland. The refuge-island, surrounded by shallow water habitat, is a major staging area for waterfowl. It is also the only undeveloped island in the Bay with public access and thus provides a unique and valuable opportunity for people to observe waterfowl in a natural setting while also learning about management practices to enhance waterfowl habitat.

According to Jonas Davis of Ducks Unlimited (Personal communication, 2007), the greatest sustainable contribution the refuge can make to the long-term conservation of Federal trust resources is to provide high quality foraging, staging, and roosting habitat for wintering and migratory waterfowl, and other migratory species, that depend heavily on the resources that Eastern Neck Island and surrounding areas provide. High quality habitat would include healthy coastal marsh, GTRs, emergent wetlands, and shallow water wetlands, standing row crops providing high caloric forage, and deep water habitats for roosting. Larry Hindman (Personal communication, 2007), waterfowl expert for MD DNR, stated that cropland management in the refuge's uplands, to provide high energy foods for wintering and migrating geese and ducks, is a critical component of management on the refuge. He also highlighted the importance of these foods is especially elevated during harsh winters.

The refuge is unique in that it is a large contiguous block of protected, undeveloped land in the critically important coastal zone where fragmentation continues to occur in surrounding counties. From a regional perspective, the refuge also provides an important sanctuary for migrating waterfowl, offering needed requirements for migrating birds, allowing them to stay and use the Bay's

resources for longer periods of time. Larry Hindman of MD DNR concurs that the refuge focus should be migratory waterfowl because it is at the center of the recent Atlantic Population (AP) Canada goose recovery (Personal communication, 2006). While there would continue to be intense hunting pressure on private lands where farmers provide ponds and standing grain to attract geese for harvest, the refuge provides sanctuary from hunting pressure, with counts as high as 60,000 around the refuge.

We evaluated the management actions proposed in the CCP alternatives for their potential to benefit waterfowl or their habitats. The benefits we considered included:

- Protection and restoration of tidal marsh and shallow water habitats surrounding the refuge
- Cropland management for feeding of “hot foods” during critical migrating or wintering periods

Other benefits we examined were:

- Refuge MSU and GTR management that would enhance refuge habitats for wintering or migratory waterfowl
- Mute swan control measures that would reduce associated problems

The potential adverse effects from proposed management on waterfowl that we evaluated included impacts from:

- Potential for loss of crops that provide “hot foods”
- Construction projects that might affect species habitats
- Public activities on the refuge that might damage habitat or disturb the species

Waterfowl Impacts That Would Not Vary by Alternative

Benefits

Regardless of which alternative we select, our continued protection and management of the refuge tidal marsh and uplands will benefit migratory and wintering waterfowl. These areas will remain undeveloped and either in larger portion or wholly in native vegetated cover in the long term, thereby sustaining a reserve of migratory and wintering habitats in the Lower Chester River Basin that would otherwise almost certainly be intensively developed. Refuge lands would also remain a waterfowl no-hunting zone to provide a sanctuary in an area that is otherwise heavily hunted.

Mute swans are an invasive species that often out-compete native waterfowl for forage and nesting areas. Under all alternatives, mute swans would be controlled with a goal of zero productivity to reduce, if not eliminate, their threat to native waterfowl.

Adverse Impacts

Water quality affects the aquatic invertebrates, plants, and fish on which wintering and migrating waterfowl depend. The water quality of the Lower Chester River Basin will continue to reflect the level of point and non-point source pollution and the effectiveness of pollution controls in the different communities of the watershed overall. We will continue to partner with agencies that address water pollution but we would not directly control any major upstream sources.

Under all alternatives, prescribed burning of invasive plants may cause minor, short-term water quality impacts such as increased turbidity and elevated nutrient levels. These effects would not likely add measurably to general turbidity and nutrient levels in the Lower Chester River Basin.



Jonathan Priddy/USFWS

Fishing on the refuge

Fishing, crabbing, and recreational boating cause disturbance to waterfowl. Recreational fishing opportunities may cause temporary disturbances such as the flushing of feeding, resting, or nesting birds, especially waterfowl, and other wildlife species. McNeal et al. (1992) found that many waterfowl species avoid disturbance by feeding at night instead of during the day. Klein (1989) found migratory dabbling ducks to be the most sensitive to disturbance and migrant ducks to be more sensitive when they first arrived, in the late fall, than later in winter. This disturbance may displace individual animals to other parts of the refuge; however, this disturbance would be limited in scope due to the limited number of areas accessible to anglers. Most visitors understand the protection afforded by the Refuge, and the Service will continue to provide educational materials and adequate signage, these instances should remain rare. Access for fishing is limited to the use of maintained roads and parking areas.

Discarded fishing line and other fishing litter can entangle migratory birds and cause injury and death (Gregory, 1991). Proper management actions, including closing sensitive areas, outreach and education, and law enforcement would ensure there would be no short or long-term impacts to waterfowl at the refuge from public fishing and other visitor activities. Providing monofilament line-disposal units at all fishing access areas would help mitigate the potential impacts of fishing litter on wildlife.

Alternative A. Current Management

Benefits

Migratory waterfowl would continue to be a management priority at the refuge and would continue to benefit from Service protection of refuge lands in general, and from specific Service waterfowl conservation measures, including cropland management and management of the moist soil units and GTRs under alternative A. Maintaining our current program to benefit waterfowl would continue to provide quality habitat that supports tens of thousands of migrating and wintering waterfowl each year and provide regionally-critical habitat during times of the year when waterfowl are most stressed and in need of rest and sanctuary.

The greatest impact of our cropland management program would be on wintering waterfowl. Cropland management has been used extensively on national wildlife refuges to provide food for migrating and wintering waterfowl and to lessen depredations on private cropland. Surveys at several refuges showed that about one-third of all feeding by waterfowl was on cultivated crops. Seventy-five percent of the geese and 30 percent of the ducks using national wildlife refuges in the Southwestern States were harbored on refuges where cropland management was practiced. Three million birds were maintained for several weeks in California on three small refuges totaling only 17,000 acres, where cropland management was practiced to minimize private cropland depredation (Givens et al., 1964). These are significant statistics relating to the contributions that croplands on refuges make to waterfowl management and the achievement of refuge purposes. Publications such as Reinecke et al. (1989); McFarland et al. (1966); Ringelman et al. (1989); and others, have repeatedly validated the scientific importance of cropland management to waterfowl.

Measures we would continue to implement to control mute swans would benefit other waterfowl and wetland breeding birds by reducing these aggressive non-indigenous birds.

Adverse Impacts

Increasing refuge visitation under alternative A may result in a minimal increase in human disturbance of waterfowl near trails or watercraft. However, the implementation of seasonal area closures, such as the Ingleside Road area, would continue to minimize human impacts in waterfowl congregation areas during the time of year when their energy reserves are low and most susceptible to disturbance. Most visitors understand the protection afforded by the refuge and respect wildlife closure areas; however, refuge staff would continue to provide educational materials and adequate signage to insure these instances of disturbance remain rare.

Alternative B. Emphasis on Tidal Wetlands and Waterfowl (Service-Preferred Alternative)

Benefits

Among the three alternatives, alternative B would provide the greatest benefits to migratory and breeding waterfowl through active management. We would manage up to 966.6 acres of tidal marsh including our current 858.8 acres and 107.8 acres of proposed restored marsh. We would manage 38 acres of GTRs and increase MSU management to 50.5 acres to sustain migrating and wintering waterfowl. We would consolidate farming operations to 371.9 acres of croplands in larger fields that will offer the same production of high quality, high energy foods for waterfowl, but in a configuration that offers a higher level of security from predation, and implemented to be more flexible to respond to crop failures and or weather conditions. Although it is difficult to predict the response, we would expect more utilization by AP Canada geese and black ducks, and possibly tundra swans, from these changes. In addition, we would expect the waterfowl using the fields to be in relatively better health when they resume migration.

Similar to alternative A, measures to control mute swans by removal of adults would benefit other waterfowl and wetland breeding birds by reducing these aggressive non-indigenous birds.

Adverse Impacts

There may be some temporary disruption in rotational cropping of fields and the realization of their value in terms of use for feeding by waterfowl during the time the croplands are being consolidated. The expectation is that any minor downturn in field use would last for at most one season.

The disturbance impacts from refuge visitors would be similar to alternative A, although the predicted increase in refuge visitation under alternative B may result in some minor increase in human disturbance of waterfowl near trails and roads, at boating access points, or in watercraft. Measures proposed to minimize those impacts are similar to alternative A.

Alternative C. Emphasis on Tidal Wetlands and Forest Habitat

Benefits

Long term management of about 858.8 existing acres and 107.8 restored acres of tidal marsh would benefit migrating waterfowl similar to alternative B. Two MSUs and the GTRs would continue to be managed and would benefit migrating waterfowl similar to alternative A.

Similar to alternative B, measures we would implement to control mute swans would benefit other waterfowl and wetland breeding birds by reducing these aggressive non-indigenous birds.

Adverse Impacts

Actions that would adversely affect waterfowl under alternative C include allowing crop fields to succeed to forested habitats. These fields are cultivated with high calorie grains that are highly desired by migrating and wintering AP

**Refuge-Specific
Impacts: Shorebird,
Marsh Bird and
Wading Bird Impact**

**Shorebird, Marsh and
Wading Bird Impacts
That Would Not Vary by
Alternative**

Canada geese, black ducks and mallards. These areas also provided a safe haven for waterfowl from hunting pressures and other human disturbances.

As noted for alternative B, increasing refuge visitation under alternative C may result in some minor increase in human disturbance of waterfowl near trails, at boating access points, or in watercraft. Because most visitors understand the protection afforded by the Refuge and the Service will continue to provide educational materials and adequate signage, these instances should remain rare.

We evaluated the management actions we propose for the alternatives for their potential to benefit shorebirds, marsh birds, and wading birds or their habitat. The benefits we considered included:

- Protection and restoration of tidal marsh
- Management of MSUs

We evaluated the potential adverse effects on these birds from the management alternatives, including impacts from:

- Construction projects that might affect species habitats
- Public activities on the refuge that might damage habitat or disturb the species

Benefits

Regardless of alternative selected, the refuge will continue to provide breeding and migratory habitat for shorebirds, marsh birds, and wading birds, although the distribution and acreage of types would vary among alternatives. In particular, shoreline protection and tidal marsh restoration would continue as the highest management priorities among the alternatives, thus directly benefiting these species groups.

Adverse Impacts

Visitors using the refuge for consumptive and non-consumptive wildlife related uses would continue to cause some minor level of disturbance of these birds at locations on the refuge where trails, boating or fishing access points are near habitats used by these birds.

Studying the effects of human visitation on waterbirds at J.N. "Ding" Darling NWR, Klein (1989) found resident waterbirds to be less sensitive to disturbance than migrants; she also found that sensitivity varied according to species and individuals within species. Ardeids (herons, egrets and bitterns) were quite tolerant of people, but were disturbed as they took terrestrial prey. Great blue herons, tricolored herons, great egrets, and little blue herons were observed to be disturbed to the point of flight more than other birds. Kushlan (1978) found that the need of these birds to move frequently while feeding may disrupt interspecific and intraspecific relationships. In addition, Batten (1977) and Burger (1981) found that wading birds were extremely sensitive to disturbance. Klein (1993), in studying waterbird response to human disturbance, found that as intensity of disturbance increased, avoidance response by the birds increased. She also found that out-of-vehicle activity is more disruptive than vehicular traffic. Freddy et al. (1986) and Vaske (1983) also found the latter to be true. Klein (1989) found that gulls and sandpipers to be apparently insensitive to human disturbance, with Burger (1981) finding the same to be true for various gull species.

We have not observed that the level of visitor activity would to any degree constitute a substantive adverse impact to species survival or reproduction.

Through refuge literature and signage, people are directed to stay on trails and to be sensitive to disturbing wildlife. Outreach, education, and if necessary, law enforcement, would continue to be tools to insure significant impacts do not occur.

In addition to causing disturbance, visitors who are fishing and crabbing may introduce litter and lead sinkers that may harm shorebirds. Disturbance impacts would be similar to those discussed above for other refuge users. No lead sinkers will be permitted during the Youth Fishing Derby to prevent lead poisoning to wading birds that use the Headquarters' Pond. Discarded fishing line and other fishing litter can entangle birds and cause injury and death. This will be reduced through the use of monofilament recovery and recycling containers at fishing access sites.

Alternative A. Current Management

Benefits

Continued protection of 858.8 acres of tidal marsh and 28.9 acres of MSUs under alternative A would benefit shorebirds, and marsh and wading birds by ensuring these habitats exist for the long-term.

Adverse Impacts

An increase in refuge visitation would minimally elevate the potential for impacts to wetlands and disturbance to shorebirds, marsh and wading birds. The potential for disturbance from refuge maintenance projects and staff using motor vehicles to monitor the MSUs and GTR would be negligible. No construction projects are planned under alternative A.

Alternative B. Emphasis on Tidal Wetlands and Waterfowl (Service-Preferred Alternative)

Benefits

Protection of 858.8 current acres and 107.8 restored acres of tidal marsh under alternative B would benefit, shorebirds, marsh and wading birds by ensuring these habitats exist for the long-term. An increase to 50.5 acres of MSUs and strategies to flood and dewater at times to optimize their use by migrating shorebirds, marsh, and wading birds would substantively increase benefits to those species.

Adverse Impacts

An increase in refuge visitation would minimally elevate the potential for impacts to wetlands and disturbance to shorebirds, marsh and wading birds. Measures to reduce those impacts would be implemented similar to alternative A. The potential for disturbance from refuge maintenance projects and staff using motor vehicles to monitor MSUs would be negligible. The refuge headquarters road realignment project has the potential to disturb birds in a nearby MSU, but the project would take into consideration the peak use times of these habitats by these species and mitigate accordingly.

Alternative C. Emphasis on Tidal Wetlands and Forest Habitat

Benefits

Protection of 858.8 current acres and 107.8 restored acres of tidal marsh would benefit shorebirds, and marsh and wading birds, for the long-term similar to alternative B. Maintaining the current MSU management of 28.4 acres would provide the same level of benefit for these species that would be provided in alternative A.

Adverse Impacts

An increase in refuge visitation would minimally elevate the potential for impacts to wetlands and disturbance to shorebirds, marsh and wading birds. The potential for disturbance from refuge maintenance projects and staff using motor vehicles to monitor the MSUs would be slightly reduced but still negligible. There would be no refuge road realignment project, but facilities expansion projects at the Tundra Swan Boardwalk and new car-top boat launch that are planned under

Refuge-Specific Impacts: Impacts to Songbirds, Raptors, and Other Birds of Conservation Concern

Songbird, Raptor and Other Bird Impacts That Would Not Vary by Alternative

alternative C have the potential to disturb birds in nearby MSUs or in the tidal marsh. However, implementation of these projects would take into consideration the peak use times of these habitats by these species and mitigate accordingly.

The refuge is an important site for migrating and breeding forest dependent birds. The Refuge also provides habitat for breeding and wintering raptors and grassland birds. Many of these species are listed as birds of greatest conservation need (GCN) by the MDDNR.

Benefits

Continued protection of refuge lands under all alternatives would generally benefit forest birds that use the refuge to breed or winter or migrate through. The bald eagle was recently removed from the Federal list of threatened and endangered species. Nevertheless, we will continue to protect nesting bald eagles and their habitat on the refuge under all alternatives. There are currently seven nesting pairs on the refuge and the refuge will continue to monitor the nests and breeding activities and prohibit the public from disturbing them.

Adverse Impacts

Regardless of alternative selected, breeding, wintering, and migrating birds may be adversely affected by management methods, such as prescribed burning or use of herbicides to control invasive plants or maintain grasslands or by construction projects. These methods would displace birds from treated locations and if any active nests are present they could be damaged or destroyed. The impacts would be minor, highly localized and short-term with no threats to bird populations in terms of adult mortality or breeding success. Treated habitats would be improved in the long term and this would benefit bird populations.

There would be a potential for disturbance to nesting eagles and other nesting birds from the use of aircraft to treat invasive gypsy moths. All requests for treatment will be based upon monitoring data. Typically, population analysis from the previous year is used to determine the need to spray with the gypsy-moth specific chemicals Gypchek® or Disrupt II in a given year. The USFS will complete an environmental assessment that addresses any treatment activities conducted on the refuge. Refuge staff will work closely in the development of the environmental assessment. Toxicological and field tests on Gypchek® show no effects for terrestrial vertebrates at concentrations greater than the application rate used to control gypsy moth. Based on these data, NPV is not expected to put any group at risk of mortality other than gypsy moth, due to its application (USDA, 1995). "The components found in Disrupt II all have low toxicity. It is classified as a low risk pesticide by the U.S. Environmental Protection Agency. Ecological toxicity studies indicate that Disrupt II is practically nontoxic to birds. Both the resin and the PVC films are essentially inert and pose no threat to the environment at the labeled application rate"(Hercon, 2002).

The refuge priority public uses — wildlife observation, photography, interpretation, and environmental education — may cause minor negative impacts to specific station physical resources such as trails and roads, and on natural resources such as vegetation and wildlife. Impacts may include erosion, deterioration, trampling, and temporary disturbance. Wildlife disturbances typically result in a temporary displacement without long-term effects on individuals or populations. Some species will avoid the areas people frequent, such as the developed trails and the buildings, while others seem unaffected by or even drawn to the presence of humans.

Long term impacts are anticipated to be minimal since only certain areas are open to the public, and sensitive areas, such as bald eagle nesting sites, will be closed as needed.

For songbirds, Gutzwiller et al. (1994) found that singing behavior of some species was altered by low levels of human intrusion. Some studies have found that some bird species habituate to repeated intrusion; frequently disturbed individuals of some species have been found to vocalize more aggressively, have higher body masses, or tend to remain in place longer (Cairns and McLaren, 1980). Disturbance may affect the reproductive fitness of males by hampering territory defense, mate attraction and other reproductive functions of song (Arrese, 1987). Disturbance, which leads to reduced singing activity, would make males rely more heavily on physical deterrents in defending territories which are time and energy consuming (Ewald and Carpenter, 1978).

Travel routes can disturb wildlife outside the immediate trail corridor (Miller et al., 2001). Miller et al. (1998) found bird abundance and nesting activities (including nest success) increased as distance from a recreational trail increased in both grassland and forested habitats. Bird communities in this study were apparently affected by the presence of recreational trails, where “generalists” (American robins) were found near trails and “specialist” species (i.e. grasshopper sparrows) were found farther from trails. Nest predation was also found to be greater near trails (Miller et al., 1998).

Disturbance can cause shifts in habitat use, abandonment of habitat and increase energy demands on affected wildlife (Knight and Cole, 1991). Flight in response to disturbance can lower nesting productivity and cause disease and death. Hammitt and Cole (1998) conclude that the frequent presence of humans in “wildland” areas can dramatically change the normal behavior of wildlife mostly through “unintentional harassment.”

Seasonal sensitivities can compound the effect of disturbance on wildlife. Examples include regularly flushing birds during nesting. The Delaware Natural Heritage Program, Division of Fish & Wildlife and the Department of Natural Resources and Environmental Control prepared a document on the “The Effects of Recreation on Birds: A Literature Review” which was completed in April of 1999. The following information was gathered from this document:

Several studies have examined the effects of recreationists on birds using shallow-water habitats adjacent to trails and roads through wildlife refuges and coastal habitats in the eastern United States (Burger, 1981; Burger, 1986; Klein, 1993; Burger et al., 1995; Klein et al., 1995; Rodgers & Smith, 1995, 1997; Burger & Gochfeld, 1998). Overall, the existing research clearly demonstrates that disturbance from recreation activities always has at least temporary effects on the behavior and movement of birds within a habitat or localized area (Burger, 1981, 1986; Klein, 1993; Burger et al., 1995; Klein et al., 1995; Rodgers & Smith, 1997; Burger & Gochfeld, 1998). The findings that were reported in these studies are summarized as follows in terms of visitor activity and avian response to disturbance.

- Presence: Birds avoided places where people were present and when visitor activity was high (Burger, 1981; Klein et al., 1995; Burger & Gochfeld, 1998).
- Distance: Disturbance increased with decreased distance between visitors and (Burger, 1986), though exact measurements were not reported.

- **Approach Angle:** Visitors directly approaching birds on foot caused more disturbance than visitors driving by in vehicles, stopping vehicles near birds, and stopping vehicles and getting out without approaching birds (Klein, 1993). Direct approaches may also cause greater disturbance than tangential approaches to birds (Burger & Gochfeld, 1981; Burger et al., 1995; Knight & Cole, 1995a; Rodgers & Smith, 1995, 1997).
- **Type and Speed of Activity:** Joggers and landscapers caused birds to flush more than fishermen, clambers, sunbathers, and some pedestrians, possibly because the former groups move quickly (joggers) or create more noise (landscapers). The latter groups tend to move more slowly or stay in one place for longer periods, and thus birds likely perceive these activities as less threatening (Burger, 1981, 1986; Burger et al., 1995; Knight and Cole, 1995a). Alternatively, birds may tolerate passing by with unabated speed whereas if the activity stops or slows birds may flush (Burger et al., 1995).
- **Noise:** Noise caused by visitors resulted in increased levels of disturbance (Burger, 1986; Klein, 1993; Burger & Gochfeld, 1998), though noise was not correlated with visitor group size (Burger & Gochfeld, 1998).

We would take all necessary measures to mitigate these effects, specifically where group educational activities are involved. Activities will be held in areas where minimal impact will occur. Periodic evaluation of sites and programs will be conducted to assess if objectives are being met and to prevent site degradation. If evidence of unacceptable adverse impacts appears, the location(s) of activities will be rotated with secondary sites, curtailed or discontinued. Refuge regulations will be posted and enforced. Closed areas will be established, posted and enforced. The known presence of a threatened or endangered species will preclude the use of an area until the Refuge Manager determines otherwise.

Special use permits will be issued to organizations conducting environmental education or interpretive and/or wildlife observation and photography tours or activities on the refuge. The areas used by such tours will be closely monitored to evaluate the impacts on the resource; if adverse impacts appear, the activity will be moved to secondary locations, curtailed or discontinued. Specific conditions may apply depending upon the requested activity and will be addressed through the special use permit.

All photographers must follow refuge regulations. Photographers in closed areas must follow the conditions outlined in the special use permit which normally include notification of refuge personnel each time any activities occur in closed areas. Use of a closed area should be restricted to inside blinds to reduce disturbance to wildlife. No baits or scents may be used. At the end of each session, the blind must be removed. All litter will be removed daily. Law enforcement patrol of public use areas should continue to minimize the above-mentioned types of violations.

Research activities that would be supported under all the alternatives may disturb fish and wildlife through observation, a variety of wildlife capture techniques, banding, and accessing the study area by foot or vehicle. For example, the presence of researchers may cause disruption of birds on nests or breeding territories, or increase predation on nests. Efforts to capture birds may cause disturbance, injury, or death to groups or to individual birds. The energy cost of disturbance may be appreciable in terms of disruption of feeding, displacement from preferred habitat, and the added energy expended to avoid disturbance. It is possible that direct or indirect mortality could result as a by-product of research

activities. Mist-netting or other wildlife capture techniques, for example, may cause mortality directly through the capture method or in-trap predation, and indirectly through capture injury or stress caused to the organism. Even if such mortalities to individual birds do occur, there would be no impact to the overall population.

The refuge would also continue to support a wild turkey hunt that provides a hunting opportunity for area youth. Though nearly extirpated due to extensive timber-cutting and unrestricted hunting, a 30-year intensive trap and translocation effort by the MD DNR with contributions from the National Wild Turkey Federation resulted in the comeback of this species throughout the State. Once primarily thought of as an upland forest bird needing expansive tracts of forest, the wild turkey in Maryland has proven to be quite adaptable and more tolerant of human encroachment than previously thought. Wild turkeys in Maryland can be found in areas comprised of mature hardwood and pine forests as well as grassy fields. The wild turkey is now well-established throughout its historic range in Maryland and can be found in every county of the State of Maryland (MD DNR, 2007). Despite the resurgence of the turkey population off the refuge, we will continue to adhere to State seasons which account for species populations and trends so there would be no long term threat to wild turkey populations from hunting on the refuge.

An indirect long term impact is the potential for visitors to unintentionally introduce and/or spread invasive species. Once established, invasive plants can out-compete native plants, thereby altering habitats and adversely affecting birds and other wildlife. The threat of invasive plant establishment will always be an issue, and will require annual monitoring, treatment and public education.

Alternative A. Current Management

Benefits

Under alternative A we would continue to benefit refuge bird species by managing for and ensuring protection of 708.1 acres of forest and 30.7 acres of grassland habitat in the long term. There would be beneficial impacts to bald eagles from our efforts to maintain a forested shoreline buffer zone, planting trees, protecting active nests and not disclosing their locations nor allowing public use in the vicinity of nests, participating in other federal and state agency's hacking programs in other areas, and conducting annual active nest searches.

Continuing the cropland management program would benefit not only wintering waterfowl but also, to a lesser degree, Neotropical migrants. Observations and censuses have demonstrated that many other resident and migratory bird species would also benefit from cropland management programs. In the summer, eastern meadowlarks and several sparrow species use the clover fields. Since the winter wheat would remain unharvested and be left to mature, wild turkeys would use these fields as preferred nesting and brooding areas. Passerines seeking seeds or invertebrates would also heavily use the mature wheat. The eastern bluebird, in particular, seems to favor these areas during most of the year. Many species of raptors, including red-tailed hawks and kestrels, are often seen hunting in these areas.

Maintaining field borders would particularly benefit sparrow species, including song sparrows (*Melospiza melodia*), swamp sparrows (*Melospiza georgiana*), field sparrows (*Spizella pusilla*), chipping sparrows (*Spizella passerina*), white-throated sparrows (*Zonotrichia albicollis*), and savannah sparrows (*Passerculus sandwichensis*) (Marcus et al., 2000). Fields with field borders contain approximately three times the sparrows than fields without borders.

Alternative B. Emphasis on Tidal Wetlands and Waterfowl (Service-Preferred Alternative)

Adverse Impacts

There would be short-term localized impacts to bird habitat and temporary displacement of birds from management practices such as mowing and prescribed burning for grassland management or herbicide treatments for invasive plant control. Trail maintenance activities would also cause negligible short-term, localized effects from disturbance. Impacts from visitor disturbance may increase minimally due to a general increase in refuge visitation.

Benefits

There would be long-term benefits to forest and grassland birds under alternative B because we would increase the acreages of these habitats on the refuge to 40.3 acres of grassland and 881.6 acres of forested habitat. Additional benefits to forest dependent birds would derive from enhancing forest diversity and reducing fragmentation. This would be accomplished by managing mature deciduous-mixed forest habitat with a diverse canopy structure and with at least 75 percent of the acreage in contiguous, unfragmented blocks of at least 25 acres of native forest, with at least two of those blocks exceeding 100 acres each.

Benefits to bald eagles would increase under this alternative. In addition to the benefits of management strategies outlined above for alternative A, we would survey for winter roosting eagles to determine if important areas are present and help develop a State regulation to establish a no disturbance zone along the shoreline to further minimize impacts to nesting bald eagles.

Construction of new low-maintenance moist soil management units would benefit raptors, particularly northern harriers that would be attracted to the dikes and levees for the small mammals that winter in the grasses. Kestrels would likewise benefit from the “edge” effects that the dikes would produce. Larger raptors, such as bald eagles, would be attracted to feed on the waterfowl during the winter.

Adverse Impacts

Management methods used to maintain or restore habitats or prevent encroachment of invasive species may affect individual birds by temporary displacement of the birds and short-term loss of their specific habitat. For example, the loss of hedgerows in consolidating crop fields would result in long term reduction of the populations of some nesting birds on the refuge, such as the white-eyed vireo and yellow breasted chat. These effects would be highly localized—limited reductions in the small numbers of these birds on the refuge—and should not affect any species populations regionally. These management measures would not be employed during the major portion of the nesting season when the majority of birds are building nests, incubating eggs or feeding nestlings, so adverse impacts to bird reproduction would not occur. Habitat improvements, particularly control of invasive plants, would benefit other bird species in the longer term.

Maintenance or construction projects proposed under alternative B, for example, building the new headquarters access road, would cause an increased degree of disturbance to land birds and remove more acreage from natural habitat than alternative A. There will be some removal of vegetation to place any new trails or trail improvements, observation platforms or photo blinds. Placement of kiosks may impact small areas of vegetation. Kiosks will be placed where minimal disturbance will occur.

Providing additional interpretive and educational brochures as well as increasing involvement with local groups in the area may result in increased knowledge of the refuge and its resources. This awareness and knowledge may improve the willingness of the public to support refuge programs, resources, and compliance

with regulations. In the event of persistent disturbance to habitat or to wildlife the activity will be restricted or discontinued. Little energy will be expended by wildlife leaving areas of disturbance because the areas would be small. Visitor disturbance would also increase because of the increase in visitation and the increased access from new and improved refuge amenities. However, these effects would be more than offset by the overall protection afforded these birds on refuge lands.

Alternative C. Emphasis on Tidal Wetlands and Forest Habitat

Benefits

Benefits under alternative C would be the similar to those described for alternative B for forest-dependent songbirds and raptors. Populations of those birds on the refuge would likely increase substantively because forest acreage would nearly double from the current acreage. Benefits to bald eagles would be similar to those described under alternative B except there would be no effort to identify and protect any winter roost areas on the refuge.

Adverse Impacts

Allowing grasslands, croplands, and hedgerows to succeed to mixed-hardwood forest cover would likely eliminate birds that require those habitats for all or a portion of their survival requirements. Grassland birds in particular would be adversely affected under alternative C because their habitat would not be maintained on the Refuge but rather will be allowed to progress through natural stages of vegetative succession, ultimately to mature forest. With the exception of a few nesting pairs on naturally-disturbed sites or local grassed areas maintained for other reasons that may appear from time to time, breeding grassland birds would likely disappear from the refuge. Because grassland is a minor portion of existing refuge habitats, loss of grassland bird breeding or stopover sites on the refuge would constitute a negligible effect to these species populations regionally.

Refuge-Specific Impacts: Impacts to Other Native Wildlife including Game Species

Mammals at the refuge—white-tailed deer, muskrats, woodchucks, squirrels, bats, shrews, and mice—are important concerns because they are an integral part of the natural ecosystems we are sustaining on the refuge, and are, therefore a part of the refuge biological diversity, integrity and environmental health. Many of the small mammals serve as prey base for diurnal and nocturnal raptors; deer is the only game mammal taken by sport hunters on the refuge. Of the 34 mammals considered by MD DNR to be species of greatest conservation need (GCN) in the State, only the Federal-listed endangered DFS is known to inhabit the refuge. We have determined that we will no longer focus our efforts on that species because further recovery efforts are best accomplished elsewhere on the Delmarva Peninsula. We will have this CCP reviewed by the Recovery Team in conjunctions with a Section 7 Intra-agency Consultation to insure the plan complies with the Endangered Species Act.

Reptiles and amphibians are also important components of the diverse ecosystems of the refuge.

Amphibians on the refuge are relatively common in the region; none are listed as of conservation concern by the State of Maryland. However, three reptiles that occur on the refuge are listed as GCN species by MD DNR, the eastern box turtle, eastern ribbon snake, and northern diamondback terrapin. The latter species is addressed in our efforts to protect refuge shoreline with sandy beach areas that would provide nest sites for this aquatic species. Box turtle and ribbon snake inhabit the wooded areas of the refuge.

Benefits

Regardless of which alternative we select, we would continue to provide a natural landscape with required habitats to support the mammalian, amphibian, and reptile species found here.

American black vulture



Jonathan Priddy/USFWS

Other Native Wildlife Impacts That Would Not Vary by Alternative

Deer hunting provides a wildlife-dependent recreational opportunity for hunters. Hunters who come from outside the local area also contribute to the local economy by staying at local hotels and eating in local restaurants. Providing deer hunting opportunities helps preserve the cultural heritage of the refuge area, where people have hunted for generations. Deer hunting also helps keep the deer population from becoming overabundant and depleting forest understory vegetation that is vital to some species of breeding birds.

Monitoring for and controlling infestations of invasive gypsy moths if they occur would benefit forest wildlife. Gypsy moths prefer oaks as a host but also feed on and defoliate many deciduous tree species found on the Eastern Shore of Maryland. Once trees are defoliated multiple times during the growing season they become stressed. The stressed trees are then extremely prone to other stressors including diseases. Death of many important oak tree species can be the ultimate result if treatment does not occur. This would have a substantial impact to many species of wildlife, including squirrels and mice that rely heavily on these trees as a food source.

Managed and unmanaged wetlands, ponds, and vernal pools provide breeding habitats for amphibians. Native vegetation provides cover and breeding substrate for reptiles.

Adverse Impacts

Refuge habitat management activities such as mowing and using prescribed fire may kill individual small mammals, such as mice, moles, and shrews, as well as any amphibians or reptiles using those fields and cause temporary disturbance or displacement of others, but there would be no significant mortality or loss of local populations because these actions would be done on a rotational basis meaning no major habitat components would be completely changed in any one given year.

Mammals at the refuge would continue to experience some minimal level of human disturbance from refuge staff and from visitors, regardless of alternative. Disturbance to non-target mammal species is likely to occur during hunting seasons.

The refuge priority public uses may impose minor negative impacts on specific station physical resources such as trails and roads, and on natural resources such as vegetation and wildlife. Wildlife disturbances typically result in a temporary displacement without long-term effects on individuals or populations. Some species will avoid the areas people frequent, such as the developed trails and the buildings, while others may be unaffected by or even drawn to the presence of humans. Long term impacts are anticipated to be minimal since only certain areas are open to the public, and sensitive areas, such as bald eagle nesting sites, will be closed as needed.

An indirect long term impact is the potential for visitors to unintentionally introduce and/or spread invasive species. Once established, invasive plants can out-compete native plants, thereby altering habitats and adversely affecting wildlife. The threat of invasive plant establishment will always be an issue, and will require annual monitoring, treatment and public education.

Allowing hunting may include disturbance of non-target species in the course of tracking prey, trampling of vegetation, possible creation of unauthorized trails by hunters, littering, possible vandalism and subsequent erosion. Shotgun noise from hunting could cause some wildlife disturbance as well. Deer hunting would continue to be allowed on the Refuge under all alternatives so direct mortality to deer from hunting would continue. However, deer are abundant across their

range and in many areas including Maryland's Eastern shore deer degrade habitat values due to their overabundance.

Despite the abundance of deer off the refuge, we will continue to adhere to State seasons which account for species populations and trends so there would be no long term threat to deer populations from hunting on the refuge.

Contaminants that might run-off into refuge MSU, GTR, or vernal ponds from cropland operations or roads and parking areas could adversely affect amphibians. Monitoring and corrective measures would continue to be taken to ensure contaminated run-off does not become a problem.

Alternative A. Current Management

Benefits

Mammalian, reptile, and amphibian species would continue to benefit as we continue to manage Refuge habitats for the benefit of wildlife under alternative A.

Adverse Impacts

The potential adverse impacts noted above for all alternatives would pertain to alternative A.

Mowing and prescribed burning would continue to occasionally injure or kill individual small mammals in grassland management units.

We would remove problem animals through lethal means only when necessary. Outreach and education programs would continue to be used to inform the general public and nearby landowners of the need for and ecological soundness of hunting and animal damage control measures. Management of some mammals, such as raccoons and groundhogs that are problems in corn production would continue to be accomplished through live-trapping and shooting. This method assures that DFS and other non-target species can be released unharmed.

Alternative B. Emphasis on Tidal Wetlands and Waterfowl (Service-Preferred Alternative)

Benefits

Mammals, reptiles and amphibians would continue to benefit from refuge management under alternative B. Small mammals that prefer grassland habitats would benefit from the increase in acreage of this type. Construction of new low-maintenance MSUs would benefit mammals, amphibians, and reptiles. Muskrats and other mammals, such as raccoons and red fox, may use the levees for shelter and travel corridors.

Adverse Impacts

Mowing and prescribed burning would continue to occasionally injure or kill individual small mammals, reptiles or amphibians in grassland management or in invasive plant control. Management of some mammals that are problems in corn production is accomplished through live-trapping and shooting. This method assures that DFS and other non-target species can be released unharmed. Mammals, such as the red fox, that benefit from the hunting cover provided by hedgerows, would likely decline in numbers as hedgerows are removed in crop field consolidation.

Any potential for hunting or trapping controversy would likely be similar to any seen under alternative A.

Alternative C. Emphasis on Tidal Wetlands and Forest Habitat

Benefits

Under alternative C forest dependent wildlife species would be favored and their populations would increase on the refuge because earlier successional habitats would be allowed to mature. We would also be able to create an almost unbroken forested buffer around the entire perimeter of the island.

Refuge-Specific Impacts: Invertebrate Impacts

Adverse Impacts

Populations of mammals that inhabit grassland habitats and on croplands, such as the meadow vole and groundhog, would decline as grasslands and croplands are allowed to grow to later successional vegetation. These species are abundant in the farmlands and other grassed areas in the eco-region so there would be no significant impacts to the regional population of these species, even if losses occur on the refuge. There would be a loss of potential to provide additional habitat favorable to amphibians and reptiles because we eliminate future MSU construction under this alternative.

The refuge and surrounding tidal waters is host to a wide variety of invertebrate species, from the butterflies that populate our grasslands to the blue crabs in the shallow waters of the tidal marsh. This great diversity of form and habitat provide a major portion of the food biomass on which refuge wildlife species depend. A number of invertebrate species are rare or declining in Maryland or nationally and are of special management concern.

We compared the potential benefits and adverse effects of the alternatives on invertebrates based on the following:

Benefits

- Benefits from refuge habitat protection and restoration
- Benefits from measures to improve water quality and restore and maintain wetlands

Adverse Effects

- Adverse effects from refuge habitat management activities
- Adverse effects from construction or maintenance projects
- Adverse effects from visitor activities

Invertebrate Impacts That Would Not Vary by Alternative

Benefits

Regardless of which alternative we select, we would continue to manage our current refuge lands to support a diversity of ecosystem components including a wide array of insects, spiders, earthworms, aquatic arthropods, and other invertebrates. Invertebrates are critical food items for insectivorous birds, bats, moles, shrews, raccoons, fish and a number of other refuge wildlife species. We would use minimal application of insecticides on the refuge for insect control in our habitats.

Improvements in water quality, tidal marsh protection and restoration efforts would benefit the shallow water habitats surrounding the refuge and benefit aquatic invertebrate populations.

Adverse Impacts

There would continue to be some losses of invertebrates, for example, ants and earthworms, from equipment used in prescribed burning and mowing to maintain grasslands and control invasive plants. These would be minimal, highly localized, and short-term and no regional invertebrate species populations would be affected.

Two chemicals are proposed for use on the refuge to control the invasive gypsy moth. There are no native controls on this population. Gypsy moths prefer oaks as a host but also feed on the foliage of many deciduous tree species that are found on the Eastern Shore of Maryland. The specific impact is that many

tree species are defoliated. Once trees are defoliated multiple times during the growing season they become stressed. The stressed trees are then extremely prone to other stressors including diseases. Death of many important oak tree species can be the ultimate result if treatment does not occur. This would have a substantial impact to many species of wildlife that rely heavily on these trees as a food source.

All requests for treatment will be based upon monitoring data. Typically, population analysis from the previous year is used to determine the need to spray in a given year. The USFS will complete an environmental assessment that addresses any treatment activities conducted on the refuge. Refuge staff will work closely in the development of the environmental assessment.

Treatments will be conducted by private aerial contractors under the supervision of USFS and USFWS. The gypsy moth specific nucleopolyhedrosis virus, Gypchek®, applied once at 4×10^{11} polyhedral inclusion bodies (PIBs) per acre in $\frac{1}{2}$ gallon of carrier is one. The second chemical is the synthetic mating disruption pheromone Disrupt® II that is labeled for application rates of 85 grams to 170 grams per acre, combined with 1.5-2.0 fluid ounces of a sticking agent per acre. The treatments will be scheduled to coincide with the most susceptible stage of the gypsy moth, depending on the substance used. Young caterpillars are targeted with Gypchek® in mid to late April. Adult moths are targeted in the first half of June when using Disrupt II. Other substances may come on the market that are species specific and exhibit very low to no negative effects on non-target organisms, in which case, their use may also be approved after thorough review. A Pesticide Use Proposal will be completed by refuge staff each year for any pesticide used as outlined in USFWS policy.

Non-target organisms include all species except the target pest (gypsy moth) that live in or near treatment sites. There are no species of butterflies found on Eastern Neck that are listed as federally or state endangered or threatened. Due to the high specificity of the Gypchek® NPV for the gypsy moth, there would be no impact on any other lepidopterans.

- Toxicological and field tests on Gypchek® show no effects for terrestrial vertebrates at concentrations greater than the application rate used to control gypsy moth. In the treated block, concentrations of NPV will be below those causing effects on fish or Daphnia, the only aquatic groups for which toxicity data exist. Based on these data, NPV is not expected to put any group at risk of mortality other than gypsy moth, due to its application (USDA, 1995).
- “The components found in Disrupt II all have low toxicity. It is classified as a low risk pesticide by the U.S. Environmental Protection Agency. Ecological toxicity studies indicate that Disrupt II is practically nontoxic to birds, mammals, fish and Daphnia (a sensitive aquatic invertebrate). Both the resin and the PVC films are essentially inert and pose no threat to the environment at the labeled application rate”(Hercon, 2002).
- During application of the Disrupt II, more than 90% of the product will be intercepted by and adhere to vegetation, where the flakes remain until leaf fall. At this point, the product will have released at least 60% of its disparlure, or pheromone. The risk of the remaining disparlure leaching into surface or groundwater via translocation after leaf fall is minimal because disparlure is insoluble in water. In laboratory experiments, Disrupt II was submerged in water and vigorously agitated for 24 hours. Under these conditions, less than 0.04% of the active ingredient (disparlure) contained in the Disrupt II leached into water. Therefore, the proposed treatments using Disrupt II are not likely to cause changes in water quality (North Carolina Department of Agriculture and Consumer Services, 2007).

- In acute toxicity tests the pheromone was not toxic to mammals, birds, or fish. At normal application rates (up to 30 grams of active ingredient per acre) concentration of the pheromone impregnated in the product remains active for one season only. Therefore, no direct, indirect or cumulative adverse effects on non-target organisms are anticipated as a result of the proposed treatment with Disrupt II. The rare and sensitive cane-feeding lepidopterans that inhabit the Corapeake block would not be affected by the proposed Disrupt II treatment under this alternative (North Carolina Department of Agriculture and Consumer Services, 2007).
- Any other substances put on the market in the future that are gypsy moth specific and do not impact non-target organisms may be acceptable upon review by service refuge and contaminants staff.

Alternative A. Current Management

Benefits

Maintaining 30.7 acres of grasslands under alternative A will benefit native butterfly species. Maintenance of MSUs will benefit dragonflies and damsel flies and other insect species.

Adverse Impacts

Burning for grassland habitat management would cause short term impacts, killing numbers of insects and other invertebrates on burn sites, but these areas would begin to recover rapidly and no long-term effects would occur.

Alternative B. Emphasis on Tidal Wetlands and Waterfowl (Service-Preferred Alternative)

Benefits

Management of up 40.3 acres of grasslands would increase benefits to native butterfly species. Expanding protection to 93 acres of GTRs and MSUs combined would increase benefits to some species of aquatic insects and invertebrates.

Adverse Impacts

Burning for grassland habitat management would cause similar short term impacts, to insects and other invertebrates on burn sites, as under alternative A.

Alternative C. Emphasis on Tidal Wetlands and Forest Habitat

Benefits

Refuge protection under alternative C will benefit invertebrates by maintaining habitat under Service protection and management.

Adverse Impacts

Loss of grassland habitat under this alternative would be detrimental to butterflies and other invertebrate species that depend on grasslands for breeding or during migration. This would be a long-term, but minor adverse impact to these species. There would be no burning or other management done to maintain grassland habitat. Burning would be limited to invasive species control which may cause short term impacts, killing numbers of insects and other invertebrates, on burn sites. However, these areas would begin to recover rapidly and no long-term effects would occur.

Refuge-Specific Impacts: Impacts to Biological Diversity, Biological Integrity, and Environmental Health (BIDEH)

Service policy 601 FW 3 provides guidance for maintaining and restoring, where appropriate, the biological integrity, diversity, and environmental health (BIDEH) within the National Wildlife Refuge System. The policy is an additional directive for refuge managers to follow while achieving refuge purpose(s) and System mission. It provides for the consideration and protection of the broad spectrum of fish, wildlife, and habitat resources found on refuges and associated ecosystems. Further, it provides refuge managers with an evaluation process to analyze their refuge and recommends the best management direction to prevent further degradation of environmental conditions; and where appropriate and

in concert with refuge purposes and System mission, restore lost or severely degraded components

Service policy 601 FW 3 also defines the following key terms:

- **Biological integrity**—“Biotic composition, structure, and functioning at genetic, organism, and community levels comparable with historic conditions, including the natural biological processes that shape genomes, organisms, and communities.”
- **Biological diversity**—“The variety of life and its processes, including the variety of living organisms, the genetic differences among them, and communities and ecosystems in which they occur.”
- **Environmental health**—“Composition, structure, and functioning of soil, water, air, and other abiotic features comparable with historic conditions, including the natural abiotic processes that shape the environment.”
- **Historic conditions**—“Composition, structure, and functioning of ecosystems resulting from natural processes that were present prior to substantial human related changes to the landscape.”
- **Native**—“With respect to a particular ecosystem, a species that, other than as a result of an introduction, historically occurred or currently occurs in that ecosystem

Installing a refuge information sign



Jonathan Priday/USFWS

BIDEH can be described at various landscape scales from refuge to ecosystem, national, and international. Individual refuges contribute to BIDEH at larger landscape scales, especially when they support populations and habitats that have been lost at those large landscape scales. When evaluating the appropriate management direction for refuges, refuge managers will consider their refuge’s contribution to BIDEH at multiple landscape scales. Service policy stipulates that first and foremost, refuge managers will maintain existing levels of biological integrity, diversity, and environmental health at the refuge scale. Secondly, refuge managers will restore lost or severely degraded elements of integrity, diversity, environmental health at the refuge scale and other appropriate landscape scales where it is feasible and supports achievement of refuge purpose(s) and System mission. At times, in pursuit of refuge purposes, individual refuges may compromise elements of BIDEH at the refuge scale in support of those components at larger landscape scales.

BIDEH Impacts That Would Not Vary by Alternative

Despite differences in habitat management activities among the three proposed alternatives, each alternative would at least maintain current levels of biological integrity and environmental health. Specifically, shoreline and tidal marsh restoration (e.g. off-shore breakwaters, on-shore armoring, and tidal marsh plantings) and invasive plant control efforts would be maintained or increased, depending on the alternative. These efforts would help protect ecosystem function and processes associated with the tidal waters in the Bay. All alternatives would also implement best management farming, forestry, and integrated pest practices. These practices would minimize impacts to soils and water quality from such things as chemical pollution and runoff, the latter which could be the result of soil disturbance from habitat management practices.

All alternatives would also maintain at least two existing water control structures and associated moist soil management units (MSUs) primarily to benefit resting and foraging migratory waterfowl on approximately 28 acres. MSUs are not a natural component of the ecosystem and it could be argued they compromise

biological integrity. However, in our professional judgment, these seasonally impounded waters make an important contribution to waterfowl populations in the region, and thereby biological diversity, due to losses of freshwater habitat in the surrounding landscape from agricultural conversion and residential and commercial development. The tradeoff on having 28 acres maintained as MSUs is a loss of what might otherwise be sustainable, naturally occurring habitat, likely forest, and the incremental benefit to forest-dependent species.

With regards to biological diversity, all alternatives emphasize managing native species at densities that are stable and sustainable, within habitat capabilities, and are not excessive in order to minimize disease, nutrient accumulation, and competitive exclusion of other species. Only native plant species would be used in habitat improvement projects. We predict that none of the alternatives would result in an extirpation of any native wildlife over the 15 years this plan would be implemented. The alternatives differ, however, in which habitat types would be a management priority, so resulting species composition over the long-term would be different among them. Significant shifts in species composition would not be predicted under any alternative for at least 10 years which is when the major habitat changes would be well underway. Finally, all alternatives contribute to biological diversity in that they include objectives that at least maintain current management actions that benefit species of conservation concern in the region including bald eagles, tundra swans, inter-jurisdictional and Federal trust fish and shellfish, and diamondback terrapin.

Regardless of those differences, we would strive for the highest degree of BIDEH achievable given staffing, funding, and the management direction proposed under each respective alternative.

Alternative A. Current Management

Although benefits are occurring under current management, alternative A would provide the least benefits among the three alternatives with respect to maintaining or restoring BIDEH in the tidal marsh and shallow waters, and would be least beneficial to the species dependent on those habitats. Current breakwaters and onshore armoring on the west side of the refuge would be maintained to continue protection of that shoreline, however, no new breakwaters would be installed allowing shoreline erosion to continue unabated over large portions of the refuge. The current marsh restoration project in that area would also continue, but would not be expanded to other areas. Continuing current management to protect tidal marsh, shallow waters and SAV beds would result in the least overall benefits for improving and expanding habitat conditions the rare tundra swan, the diamondback terrapin, and for inter-jurisdictional Federal trust fish and shellfish resources, when compared to the expanded efforts proposed under alternatives B and C.

Alternative A would be less beneficial than alternative B in maintaining or restoring BIDEH, especially waterfowl diversity and integrity, in the upland areas of the refuge. Specifically, the current crop field configuration poses less desirable security conditions for geese and other waterfowl foraging in the region on the carbohydrate-rich “hot foods” which are important to sustaining them during migration and wintering. Alternative A would, however, provide greater benefits to waterfowl than alternative C. The latter alternative would convert all crop fields to forest, dramatically reducing the benefits for waterfowl.

Alternative A provides slightly less grasslands (at approximately 30 acres) than alternative B (at approximately 40 acres), but more than alternative C (at 1 acre). Even at this small scale, the presence of grasslands introduces a measure of habitat diversity to the refuge’s uplands. This habitat is used by songbirds and butterflies for foraging and resting, especially during migration.

Alternative B. Emphasis on Tidal Wetlands and Waterfowl (Service-Preferred Alternative)

As noted under alternative A, alternative B would be more beneficial for maintaining or restoring BIDEH in tidal marsh than alternative A. In addition to maintaining current breakwaters to protect 8,700 feet of west shoreline and tidal marsh, new breakwaters would also be installed to greatly reduce erosion along 25,000 feet of southern and southwestern shoreline. Also, tidal marsh restoration efforts would be increased by approximately 107 acres over current levels in these new areas, providing important benefits to many wildlife and aquatic species dependent on this habitat type. Species of conservation concern that may benefit from these increased acres of tidal marsh, shallow water, and SAV beds, include the rare tundra swan, the diamondback terrapin, and several Federal trust fish and shellfish.

Alternative B would be more beneficial for BIDEH than alternative A with respect to restoration of historic natural conditions on the refuge uplands. Crop fields would be reduced from the 557 acres to 372 acres, and those that remain cropland would be consolidated in fewer fields, allowing the remaining 185 acres to revert to forest. This would increase the amount of native forest on the refuge and would contribute to a less fragmented habitat.

As stipulated in Service policy 601 FW 3, Part 3.14D, on some refuges, including many of those that have a purpose for migratory bird conservation, we may establish goals and objectives to maintain densities higher than those that would naturally occur at the refuge level because of the loss of important habitats in the larger landscape context. We consider one of the most significant contributions this refuge can make to conserving wildlife is that of sustaining the diversity and integrity of migratory and wintering waterfowl populations in the region to help fulfill the goals of the North American Waterfowl Plan and its Joint Ventures. Alternative B would be the most beneficial alternative for sustaining waterfowl populations at the landscape level because, in addition to the increased tidal marsh restoration and managing more MSUs (see below), it would enhance the effectiveness of existing farming practices to produce carbohydrate-rich “hot foods” for migratory and wintering waterfowl that is not provided elsewhere on a sustainable basis in the Chester River Basin. These foods are especially important in the region during harsh winters. Alternative B would also improve existing management by providing that forage in a configuration of crop fields that enhances security cover for waterfowl, and increasing the likelihood of its utilization. An adaptive management strategy would also be employed under alternative B to evaluate this program and enhance its effectiveness.

Alternative B would also increase benefits to biological integrity, compared to alternative A, through improvements to its invasive plant control program (e.g. prioritizing actions based on effectiveness) and because of plans to conduct a bi-annual forest health assessment to evaluate the risk from forest pests and pathogens, wildfire, or other threats, and to identify actions to protect the health and integrity of forest stands. Further, in addition to implementing best management farming practices, compared to alternative A, the reduction and consolidation of crop fields proposed under alternative B, would further minimize any potential for impacts to soil and water quality from farming practices.

Alternative B would increase the number of water control structures and MSUs from the 3 proposed under alternative A (on approximately 28 acres), to 7 MSUs (on approximately 50 acres) and would manage them to benefit not only migratory waterfowl, but shorebirds and water birds as well. MSUs contribute both foraging and resting habitat for birds. As discussed under “BIDEH impacts that would not vary among the alternatives,” some would argue that this management would increase adverse impacts on biological integrity since MSUs are not a natural component of the ecosystem. Our response remains that, in our professional judgment, this manufactured freshwater habitat is vitally important to migratory birds due to losses of freshwater habitat elsewhere in the region. The tradeoff on those 50 acres managed as MSUs, which we believe is more than

offset by the benefits derived to waterfowl and other migratory birds, would be a loss of what might otherwise be sustainable, naturally occurring habitat, likely forest, and the incremental benefit to forest-dependent wildlife.

Alternative C. Emphasis on Tidal Wetlands and Forest Habitat

Alternative C would provide the same benefits to BIDEH in refuge tidal wetlands as alternative B because the same actions are proposed to protect and restore shoreline, tidal marsh, shallow water and SAV beds. As such, the same habitat benefits would result to such species of concern as the rare tundra swan, the diamondback terrapin, and several inter-jurisdictional and Federal trust fish and shellfish.

Historic natural conditions are recommended as an ecological frame of reference in Service policy 601 FW 3, Part 3.12, to compare and contrast how much refuge habitats have been impacted, and how those impacts might affect BIDEH. Compared to alternatives A and B, implementing alternative C would result in more habitat in historic natural conditions because native forest vegetation, most likely the pre-settlement cover type, would be restored to the greatest extent. All 557 acres in existing crop fields would revert to forest, reducing fragmentation of the existing forest stands and improving habitat conditions for interior forest wildlife. Some of those interior wildlife species, such as the wood thrush, are species of conservation concern in the region. This habitat conversion would also be coupled with the improved invasive plant control program and the bi-annual forest health assessments that are similarly proposed under alternative B.

As highlighted under alternative B, waterfowl are a key component to species diversity on the refuge and, in our professional judgment, sustaining them during migration and winter is one of the most significant contributions this refuge can make to conserving wildlife in the region. At the landscape level, alternative C would be the least beneficial alternative to sustaining migratory waterfowl in the region primarily because it would eliminate farming practices on 557 acres and would convert it to forest. Those farmed acres produce high carbohydrate “hot foods” important to waterfowl in the region during migration and winter. Over time, the loss of upland foraging habitat would significantly diminish the presence of such species as AP Canada geese and American black duck on and near the refuge during migration and in winter. However, under alternative C, approximately 28 acres would continue to be maintained in MSUs to provide some benefit to migratory waterfowl.

Alternative C would provide the greatest benefits to environmental health by eliminating farming practices and any potential for impacts to soil and water quality from those practices and allow those lands to convert to forest. As noted earlier, the proposed bi-annual forest health assessment would allow for early detection of forest pests and pathogens, and would help identify the risk from wildfire or other threats. It would also identify actions to protect the health and integrity of forest stands over the long-term.

Refuge-Specific Impacts: Impacts to Archaeological and Historic Resources

Archeological and Historic Resources Impacts That Would Not Vary by Alternative

The Service recognizes the importance of continued compliance with the National Historic Preservation Act, and other federal laws and mandates protecting these resources, to assure that known sites are protected and any sites that are found in the course of Refuge management and public use are properly addressed.

Benefits

Areas with potential to contain cultural, archeological, or historic resources would be protected regardless of which alternative we select. We would continue to conduct outreach and education, and use law enforcement if necessary, to protect against loss or damage to these resources. Museum properties would also continue to be stored to protect their deterioration.

Adverse Impacts

Increased visitation and increased opportunities for consumptive and non-consumptive uses would also increase the likelihood of damage or disturbance of cultural and historic resources on the refuge. However, those effects should not be significant, since almost all public uses would occur in specific footprints on the refuge, such as refuge trails. We would take all necessary precautions to ensure that no sites or structures considered eligible for listing on National Register of Historic Places would be affected. This EA will be sent to the MD SHPO for review of NHPA Section 106 compliance, and we will also continue to do Section 106 compliance for all individual projects.

Alternative A. Current Management

Benefits

Continued Service protection of refuge lands would benefit cultural resources by ensuring that none of the substantial impacts related to development for other uses would affect known or as yet undiscovered cultural, archeological, and historic resources on those lands.

Adverse Impacts

There is some risk that refuge visitors may inadvertently or intentionally damage or disturb known or as yet undiscovered cultural artifacts or historic properties on the refuge. We would manage these resources to protect sites, structures, and objects of importance for scientific study, public appreciation and socio-cultural use by complying with Section 106 of the NHPA, as amended, promoting academic research on, or relating to, Refuge lands, adding Archeological Resource Protection Act (ARPA) language to appropriate public use materials to warn visitors about illegal looting, and by maintaining law enforcement personnel trained in ARPA enforcement.

Alternative B. Emphasis on Tidal Wetlands and Waterfowl (Service-Preferred Alternative)

Benefits

There would be increased benefits to cultural, archeological, and historic resources under alternative B because of our increased partnering efforts to locate and protect those resources, particularly those at high risk of damage from erosion along the refuge shoreline, and because we would seek to foster greater appreciation of their value by the general public. Specifically, management steps to increase protection of the refuge's shoreline, and to protect and restore tidal marsh, are direct ways we plan to minimize the impacts from erosion under alternative would also include cultural resources information in environmental education and interpretation programs to interpret Native American history and prehistory, survey potential prehistoric sites and describe the importance of refuge archaeological resources in interpretive programs.

Under alternative B, we would also improve our museum property storage conditions to insure they meet Federal preservation standards established by the National Park Service.

Adverse Impacts

Removal of hedgerows to establish larger, consolidated crop fields under this alternative might affect hedgerows that are considered part of the historic landscape on the refuge because they demarcate historic property boundaries. Impacts could also be realized from the proposed new MSU levee constructions. We would perform archaeological reviews, surveys, or studies of project areas as needed or recommended by the Service's Regional Archeologist and consult with the Maryland SHPO regarding refuge undertakings that have potential to affect archaeological resources. Increased visitation and increased opportunities for consumptive and non-consumptive uses would combine to increase the likelihood of damage or disturbance of cultural and historic resources on the refuge. We would monitor known prehistoric sites on the Refuge to protect from looting and other ARPA violations.

Alternative C. Emphasis on Tidal Wetlands and Forest Habitat

Benefits and adverse effects to cultural and historic resources would be similar to alternative B.

Similar to hedgerow removal, allowing all croplands and other upland cover to succeed to forests would eventually eliminate the hedgerows that may be considered part of the historic landscape. We would perform archaeological reviews, surveys, or studies of project areas as needed or recommended by the Service's Regional Archeologist and consult with the Maryland SHPO regarding refuge undertakings that have potential to affect archaeological resources. Increased visitation would increase the potential impacts to the resources but allowing the refuge lands to succeed to later stages of vegetation would tend to diminish the likelihood of impacts to these resources.

Refuge-Specific Impacts: Impacts on Public Uses—Wildlife Observation and Photography

Providing opportunities for compatible public uses, including hunting, fishing, environmental education, interpretation, wildlife observation and photography is integral to our overall management of the refuge. These uses are priority uses of the Refuge System under the National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. 668dd-668ee), as amended by the National Wildlife Refuge System Improvement Act of 1997 (Public Law 105-57).

We evaluated the alternatives by considering the extent to which refuge access for pursuing priority uses would stay the same, improve, or diminish under each alternative, as well as the opportunities for appropriate and compatible non-priority uses. Given regional recreational trend information, and our expectations of what will result based on current and proposed visitor services, we predict that over the next 15 years annual visitation to the refuge would increase by 10%, 15% and 20% under alternatives, A, B, and C, respectively.

Wildlife Observation & Photography Impacts That Would Not Vary by Alternative

Benefits

Regardless of the alternative, we would continue to provide public wildlife observation and photography opportunities. We would continue to maintain refuge facilities including the refuge headquarters, the foot trails, water trail and parking areas, observation platforms, and kiosks. We believe, despite predicted increases in annual visitation over the next 15 years, that we can accommodate those increases without impacting natural resources or diminishing the quality of experience for other visitors. This would be managed by encouraging group activities and programs, attempting to distribute those activities throughout the year, and increased outreach and education.

We do not predict any major conflicts between or among visitors engaged in various activities on the refuge regardless of alternative. In our observations this is rare, and likely to occur only at concentration areas such as Ingleside Recreation Area.

Adverse Impacts

Public use may be affected temporarily during prescribed burning activities to manage the grasslands or control invasive plants, but the impact should be minimal because most burn project areas are small, burning is usually done during seasons of low visitation, and weather conditions required for burns to occur would ensure that smoke disperses readily. Seasonal area closures to protect wildlife from disturbance during sensitive times of the year would continue to result in a few complaints by some visitors who want access, but most people understand the need and value of this inconvenience and respect our decision.

Alternative A—Current Management

Viewing platform on the refuge



Jonathan Priddy/USFWS

Benefits

There would be no changes to public use as it is currently conducted under alternative A. The same opportunities considered benefits would continue.

Adverse Impacts

There continues to be increasing development pressure and concomitant demand for outdoor recreational opportunities in Kent County and other parts of the Bay region. These will likely lead to an increase in user conflicts and enforcement issues on the refuge if no improvements or additional opportunities are provided.

Benefits

Benefits to public users would substantively increase under alternative B. We plan to increase public use opportunities in a few areas and improve the quality of existing programs. The quality of interpretive materials would improve at existing trails.

In alternative B a number of construction projects will expand opportunities for the public to participate in wildlife observation and photography. We would formalize partnerships with environmental organizations, including Kent County Bird Club, to provide birding programs at the refuge. Within 5 years of CCP approval, we propose to have at least 90 percent of planned trail upgrades of existing trails, observation platforms and photography blinds available for use including:

- Repair to the launching site at Ingleside Recreation Area
- Resurface and re-curb the Bayview Butterfly Trail
- Clear the spur trail on the Wildlife Trail that leads to a photo blind

The more populated communities in the area are increasingly seeking outdoor recreational activities. Publicity on these improvements would likely increase public use.

Adverse Impacts

Refuge increased visitation, and increased compatible wildlife-oriented opportunities for non-consumptive uses would combine to increase the risk of human-wildlife conflicts and habitat damage. There would likely be more instances of trespassing in unauthorized areas of the refuge. There would be a greater likelihood of minor injuries or accidents by trail users. There may be associated parking issues during times of heavy use when lots fill and people attempt to park in unauthorized locations.

Alternative C. Emphasis on Tidal Wetlands and Forest Habitat

Benefits

There would be additional benefits in terms of increased public use opportunities under alternative C. We would extend the Tundra Swan Boardwalk for fishing and add a car-top boat launch and a trail on the southern portion of the refuge after careful evaluation of a location that would minimize additional safety and security risks, and/or risks to refuge resources.

Adverse Impacts

Some public use opportunities would be adversely affected. Wildlife observation and photography opportunities related to the refuge grasslands would be eliminated although we would continue to maintain the BayScape garden and trail.

**Refuge-Specific
Impacts: Impacts
on Public Use—
Environmental
Education and
Interpretation**

**Environmental Education
and Interpretation Impacts
That Would Not Vary by
Alternative**

Regardless of the alternative we select, we would continue to provide opportunities for environmental education and interpretation on the refuge. We anticipate that the Friends of Eastern Neck Refuge, volunteers, regional educational institutions, and researchers will continue to help us support these activities on the refuge because of the importance of the resources on the refuge, our location on the Bay, and the proximity of the major Baltimore-Washington DC metropolitan areas.

As with the other public uses there will be some minor localized disturbances to habitats and wildlife as these programs are conducted. Maintaining kiosks to provide interpretive materials involves localized loss of habitat values. Staff time and resources that might otherwise be used for habitat management activities must be committed to these programs to make them successful. Nevertheless, we expect that continuing to educate the public and interpret the wildlife resources of Eastern Neck refuge under all alternatives will engender a sense of long term stewardship of the refuge that will more than offset any disturbance these programs might cause and any staff and resource commitments we must make.

**Alternative A. Current
Management**

We would be able to provide only a minor increase in efforts to support environmental education and interpretation opportunities under alternative A.

**Alternative B. Emphasis
on Tidal Wetlands and
Waterfowl (Service-
Preferred Alternative)**

Benefits

With additional volunteer involvement, we would be able to provide increased efforts to support environmental education and interpretation opportunities on the refuge under alternative B.

Adverse Impacts

Our increased efforts to support environmental education and interpretation opportunities on the refuge would likely increase visitation on the refuge and result in minor disturbance to wildlife that accompanies virtually all public uses. Because the visitation would be in larger groups the wildlife disturbance might be higher than it would be with individuals or smaller groups. However, these groups would be led by educators or other sponsors so would not contribute to disturbance in unauthorized areas of the refuge.

**Alternative C. Emphasis on
Tidal Wetlands and Forest
Habitat**

Alternative C would result in the same impacts as alternative B.

**Refuge-Specific
Impacts: Impacts on
Public Use—Hunting**

**Hunting Impacts That
Would Not Vary by
Alternative**

Regardless of the alternative, we would continue to provide deer hunting opportunities for the same number of adult hunters (up to 600/year) and youth hunters (up to 50/year) as well as opportunities for youth turkey hunting. Areas on the refuge closed to hunting would continue to be around refuge facilities and the Hails Point area. Chapter 2 maps 2-6 and 2-7 depict respective hunt areas.

Youth turkey hunt on the refuge



Jonathan Priddy/USFWS

Alternative A. Current Management

Agricultural fields are locations where hunters may be more successful in terms of effort required to harvest a deer or turkey because movement through the fields is less impeded by forest undergrowth and because visibility or sight distance of hunters looking for deer is greater in fields.

Alternative B. Emphasis on Tidal Wetlands and Waterfowl (Service-Preferred Alternative)

As under alternative A, deer and turkey hunters would be constrained by vegetation to hunt in only certain areas of the refuge. Reduction in the acreage and consolidation of the agricultural operations to larger fields might somewhat reduce the extent of locations where hunters would be more successful in terms of effort required to harvest a deer or turkey.

Alternative C. Emphasis on Tidal Wetlands and Forest Habitat

Reversion of grassland and cropland management areas to forest may, on the one hand, increase opportunities for successful deer and turkey hunting on the refuge because fewer constraints would be placed on hunters as to refuge areas that would be closed. In addition a variety of successional stages of forest growth would likely be more productive in term of increased deer and turkey populations. On the other hand, the loss of crop fields and grasslands under alternative C, which allowed hunters more ease of movement and visibility of deer and turkey, would likely offset the benefits derived from improved habitat quality and increased production potential for deer and turkey. In summary, no significant change in hunter success is predicted; however, those hunters who prefer a more natural forested setting for hunting would benefit.

Refuge-Specific Impacts: Impacts on Public Use—Fishing and Boating

We evaluated opportunities for refuge visitors to engage in fishing, crabbing and boating on and near the refuge under the alternatives and considered what factors might enhance those opportunities or adversely affect them.

Fishing and Crabbing Impacts That Would Not Vary by Alternative

Benefits

Under all the alternatives we would continue to permit fishing and crabbing access from the refuge entrance bridge, Tundra Swan Boardwalk, Boxes Point Trail, Duck Inn Trail, Ingleside Recreation Area, and Bogles Wharf. Canoeists and kayakers would have the use of the water trail under all alternatives.

Alternative A. Current Management

Adverse Impacts

Under all alternatives, resource protection would in every instance override interests of fishermen and boaters. The refuge marshes would continue to be off-limits to boaters; no landings in the marsh would be allowed. Fishing would continue to be restricted to only those locations where refuge regulations permit it and signage so indicates. The open waters of the tidal marsh are State waters so boaters would continue to be subject to State of Maryland regulations for boating and fishing in the tidal waters of the Bay and Chester River.

Benefits

Anglers and boaters would continue to benefit under this alternative from our maintaining fishing and boating opportunities on the refuge. Continued protection of the tidal marsh, and shoreline, and partner efforts to address water quality and SAV problems in the Lower Chester River Basin would help sustain the fishing and crabbing resource base.

Adverse Impacts

Fishing and boating activities that have the potential to damage refuge resources may occur more frequently under this alternative because there would be no expanded efforts to restrict access locations where resource damage is being done. There would be no additional efforts to designate restricted access locations, close sites, or provide general information.

Alternative B. Emphasis on Tidal Wetlands and Waterfowl (Service-Preferred Alternative)

Benefits

We would not make any major facilities improvements under alternative B, but we would enhance our program for recreational boating and fishing by prominently displaying general information on the fishing program and refuge specific rules and regulations through the refuge website, informational signs at parking areas, trailheads and the refuge entrance road, and at refuge headquarters. We would also provide monofilament line-disposal units at all fishing access areas.

Increased efforts to protect the tidal marsh and shoreline, and increased efforts in partnership efforts to address water quality and SAV problems in the Lower Chester River Basin would enhance our current measures to sustain the fishing and crabbing resource base.

Adverse Impacts

Protecting refuge resources may lead to additional constraints on fishing and boating opportunities. We would establish designated shoreline and boat fishing access locations where resource damage is a concern and some sites may be closed periodically to reduce resource damage, or minimize conflicts with other habitat management activities. Notification of closures would be posted on the refuge website and on signs located at the refuge entrance and parking areas at least 48 hours prior to its closure, except in case of emergency requiring closure on less notice. We would also address the potential for unauthorized activities by establishing a new park ranger/law enforcement officer on the refuge who would conduct outreach and enforcement.

Alternative C. Emphasis on Tidal Wetlands and Forest Habitat

Benefits

In addition to the increased informational program under alternative B, alternative C would provide increased opportunities for fishing and boating. We would extend the Tundra Swan Boardwalk for fishing and add a car-top boat launch on the southern end of the refuge, assuming a suitable location can be found.

Increased efforts to protect the tidal marsh and shoreline, and increased efforts in partnership efforts to address water quality and SAV problems in the Lower Chester River Basin would enhance our current measures to sustain the fishing and crabbing resource base.

Adverse Impacts

Similar to alternative B, we would address the potential for unauthorized activities under alternative C by establishing a Park Ranger/law enforcement officer to conduct outreach and enforcement.

The impacts of the alternatives are summarized and presented in comparative form in Table 4.1.

Refuge-Specific Impacts: Cumulative Impacts

According to the Council on Environmental Quality NEPA implementing regulations at 40 CFR 1508.7, “cumulative impact” is the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

This cumulative impacts assessment includes other agencies’ or organizations’ actions if they are interrelated and influence the same environment. Thus, this analysis considers the interaction of activities at Eastern Neck refuge with other actions occurring over a larger spatial and temporal frame of reference.

Air Quality

Air quality in Kent County is good, with ozone being the only pollutant of concern in recent years having reached levels considered unhealthy for sensitive subgroups as recently as 2004. Ground-level ozone is formed by a chemical reaction between volatile organic compounds (VOCs) and oxides of nitrogen in the presence of sunlight. Sources of VOCs and oxides of nitrogen include: automobiles, trucks, and buses; large industry and combustion sources such as utilities; small industry such as gasoline dispensing facilities and print shops; consumer products such as paints and cleaners; off-road engines such as aircraft, locomotives, construction equipment, and lawn and garden equipment. Ozone concentrations can reach unhealthy levels when the weather is hot and sunny with relatively light winds (EPA, 2007). Short-term, negligible, localized air quality effects would be expected from air emissions of motor vehicles used by staff and Refuge visitors and from equipment such as mowers or harvesters used by Refuge staff and cooperative farmers. However, none of the activities on the refuge is expected to contribute to any measurable incremental increase in ozone levels. None of the alternatives are expected to cause any greater than negligible cumulative adverse impacts on air quality locally in the vicinity of Eastern Neck refuge or regionally.

We predict no cumulative impacts to Class I airsheds from our actions. Visibility concerns due to emission-caused haze, at the nearest Class I airshed, would not be affected by any of the proposed management alternatives. Although prevailing weather patterns are from the west, air emissions from Kent County would be completely dispersed before reaching that Class I area.

With our partners, we will continue to contribute to improving air quality through management of native upland and wetland vegetation which assures these areas will continue to filter out many air pollutants harmful to humans and the environment.

Water Quality

There would be no significant adverse cumulative impacts to water quality under any of the alternatives. Best management practices and erosion and sediment control measures would continue to be used in cooperative farming operations and on road construction sites to ensure impacts are minimized.

Socioeconomic Resources

We expect none of the alternatives to have a significant adverse cumulative impact on the economy of the Rock Hall community or of Kent County, MD. None of the three proposed alternatives would be expected to substantially alter the

local community's demographic characteristics. As a result, no impacts would be associated with changes in the community character or demographic composition.

Implementation of any of the alternatives would result in several minor beneficial impacts for the social communities near the refuge and in the region as a whole. Public use of the refuge would be expected to increase, thereby increasing the number of visitor days spent in the area and correspondingly the level of visitor spending in the local community. Fully funding the additional staffing under alternatives B and C would also make a small, incremental contribution to employment and income in the local community.

Soils

The greatest past, present, and foreseeable future adverse impacts on the refuge soils occurred in the past from agriculture and development. Alternative A would have the greatest cumulative impacts to soils because we would continue to manage 571 acres in cropland, and some level of rain and wind erosion and compaction from farming equipment is unavoidable. Alternative B, with reduced cropland acreage under management (372 acres) would have correspondingly lower cumulative soil effects. We would continue to use best management farming practices to minimize impacts from our cropland management program under alternatives A and B while keeping the remainder of the refuge in native plant communities that would otherwise have been under development if the refuge had not been created. Under alternative C, we propose to eliminate cropland management altogether and allow the refuge to revert to native forest cover which would provide the highest level of soil protection.

Protected Habitats and Species

We evaluated the cumulative impacts of the alternatives to waterfowl on the basis of the value of the refuge in providing sanctuary, high-quality foods, and shelter for migrating and wintering AP Canada geese and dabbling ducks. Because the refuge plays such a vital role in waterfowl survival on Maryland's Upper Eastern Shore, elimination of farming on the refuge under alternative C would be expected to cause significant cumulative adverse effects to waterfowl. Apart from this important effect, the refuge's tidal marsh and associated shallow water habitats would continue to serve as a sanctuary, resting and feeding area for other migrating and wintering waterfowl species under all the alternatives.

We evaluated the cumulative effects of the alternatives on tidal marsh, SAV and shallow water environments in the Bay on the basis of the continuing loss of these critical ecosystem components Bay-wide. There would be significant beneficial cumulative effects of the extensive shoreline protection and tidal marsh restoration programs under alternatives B and C, most directly by maintaining and reversing the trend of marsh and shoreline loss that would lead to the eventual loss of these habitats on the island and the disappearance of the island itself in the much longer term.

Biological resources that we would manage to control, prevent or eliminate, such as invasive plants or mute swans, are not natural components of the Eastern Neck tidal marsh or island upland ecosystems, so losses of those biotic components where they occur would not be considered adverse under any of the alternatives.

The habitats that we would maintain restore, or expand under the different alternatives would all contribute at least minimally to sustaining those habitats in the Chesapeake Bay region and would be a long-term beneficial cumulative impact. Loss of grasslands under alternative C would be a negligible long-term adverse impact to grassland habitats and grassland-dependent wildlife regionally. Loss of hedgerows under alternatives B and C also would constitute a negligible long-term adverse cumulative impact to that habitat type and species such as the white-eyed vireo and yellow-breasted chat regionally.

There may be some minimal impacts to the refuge and state deer populations from deer hunting. The refuge hunts occur before the state season, and deer move between the main land and the refuge depending on hunting pressures. This timing allows the deer herd to recover more readily from the refuge and state season hunts. The deer population on the mainland is monitored by the state, while the refuge maintains data on the population utilizing the refuge. It will be important to continue annual monitoring and evaluate the effects of the refuge seasonal hunt on the deer population. Refuge staff will collaborate with the state, and apply adaptive management as needed.

Cumulative impacts from research would only occur if multiple research projects were occurring on the same resources at the same time or if the duration of the research is extreme. No cumulative impacts are expected and the Refuge Complex Project Leader can control the potential for cumulative impacts through special use permits. Managers retain the option to prohibit research on the refuge which does not contribute to the purposes of the refuge or the mission of the Refuge System, or causes undue resource disturbance or harm.

Public activities on the refuge associated with wildlife observation, wildlife photography, interpretation, and environmental education would cause cumulative impacts: minor when considered alone, but important when considered collectively. Our principal concern is repeated disruptions of nesting, resting, or foraging birds. Our knowledge and observations of the affected areas on the refuge show no evidence that these four, priority, wildlife dependent uses cumulatively will adversely affect the wildlife resource. We also have not observed significant resource degradation, long-term consequences, or cumulative effects on any of the refuges with established programs. However, opening refuge lands to public use can often result in littering, vandalism, or other illegal activities on the refuges.

Although we do not expect substantial cumulative impacts from these four priority uses in the near term, it will be important for refuge staff to monitor those uses and, if necessary, respond to conserve high-quality wildlife resources. Refuge staff, in collaboration with volunteers, will monitor and evaluate the effects of these priorities public uses to discern and respond to any unacceptable impacts on wildlife or habitats. To mitigate those impacts, the refuge will close areas where such birds (e.g. bald eagles) are nesting.

Cultural, Archeological, and Historic Resources

We expect none of the alternatives to have significant adverse cumulative impact on cultural resources on the refuge. Beneficial impacts would occur at various levels, depending on the alternative, because of proposed shoreline erosion monitoring and control efforts, environmental education and interpretation programs, and increased field surveys to identify and protect any discovered sites.

Climate Change

Department of the Interior Secretarial Order 3226 states that “there is a consensus in the international community that global climate change is occurring and that it should be addressed in governmental decision making...This Order ensures that climate change impacts are taken into account in connection with Departmental planning and decision making.” Additionally, it calls for the incorporation of climate change into long-term planning documents such as the CCP:

“Each bureau and office of the Department will consider and analyze potential climate change impacts when undertaking long-range planning exercises, when setting priorities for research and investigations, when developing multi-year management plans, and/or when making major decisions regarding the potential utilization of resources under the Departments purview. Departmental activities covered by this

Order include, but are not limited to, programmatic and long-term environmental reviews undertaken by the Department, management plans and activities developed for public lands, planning and management activities associated with oil, gas and mineral development of public lands, and planning and management activities of water projects and water resources” (USFWS, 2008).

The Wildlife Society published an informative technical review report in 2004 titled “Global Climate Change and Wildlife in North America” (Inkley et al., 2004). It interprets results and details from such publications as the Intergovernmental Panel on Climate Change (IPCC) reports (1996-2002) and describes the potential impacts and implications on wildlife and habitats. It mentions that projecting the impacts of climate change is hugely complex because not only is it important to predict changing precipitation and temperature patterns, but more importantly their rate of change, as well as the exacerbated effects of other stressors on the ecosystems. Those stressors include loss of wildlife habitat to urban sprawl and other developed land uses, pollution, ozone depletion, exotic species, disease, and other factors. Projections over the next 100 years indicate major impacts such as extensive warming in most areas, changing patterns of precipitation, and significant acceleration of sea level rise. According to the TWS report, “...other likely components of on-going climate change include changes in season lengths, decreasing range of nighttime versus daytime temperatures, declining snowpack, and increasing frequency and intensity of severe weather events” (Inkley et al., 2004). The TWS report details known and possible influences on habitat and wildlife, including: changes in primary productivity, changes in plant chemical and nutrient composition, changes in seasonality, sea level rise, snow, permafrost, and sea ice decline, increased invasive species, pests and pathogens, and impacts on major vertebrate groups.

The effects of climate change on populations and range distributions of wildlife are expected to be species specific and highly variable, with some effects considered negative and others considered positive. Generally, the prediction in North America is that the ranges of habitats and wildlife will generally move upwards in elevation and northward as temperature rises. Species with small and/or isolated populations and low genetic variability will be least likely to withstand impacts of climate change. Species with broader habitat ranges, wider niches, and greater genetic diversity should fare better or may even benefit. This will vary depending on specific local conditions, changing precipitation patterns, and the particular response of individual species to the different components of climate change (Inkley et al., 2004). The report notes that developing precise predictions for local areas is not possible due to the scale and accuracy of current climate models, which is further confounded by the lack of information concerning species-level responses and to ecosystem changes, their interactions with other species, and the impacts from other stressors in the environment. In other words, only imprecise generalizations can be made about the implications of our refuge management on regional climate change.

Our evaluation of the proposed actions concludes that only two activities may contribute negligibly, but incrementally, to stressors regionally affecting climate change: our prescribed burning program and our use of vehicles and equipment to administer the refuge. We discuss the direct and indirect impacts of those activities elsewhere in chapter 4. We also discuss measures to minimize the impacts of both. For example, with regards to prescribed burning, we follow detailed burn plans operating only under conditions that minimize air quality concerns. In addition, many climate change experts advocate prescribed burning to manage the risk of catastrophic fires (Inkley et al., 2004). With regards to our equipment and facilities, we are trying to reduce our carbon footprint wherever possible by using alternative energy sources and energy saving appliances,

and using recycled or recyclable materials, along with reduced travel and other conservation measures.

In our professional judgment, the vast majority of management actions we propose would not exacerbate climate change in the region or project area, and in fact, some might incrementally prevent or slow down local impacts. We discuss our actions relative to the 18 recommendations the TWS report gives to assist land and resource managers in meeting the challenges of climate change when working to conserve wildlife resources (Inkley et al., 2004).

Recommendation #1: Recognize global climate change as a factor in wildlife conservation: This recommendation relates to land managers and planners becoming better informed about the consequences of climate change and the variability in the resources they work with.

The Service is taking a major role among Federal agencies in distributing and interpreting information on climate change. There is a dedicated webpage to this issue at <http://www.fws.gov/home/climatechange/>. The Service's Northeast Region co-hosted a workshop in June 2008 titled "Climate Change in the Northeast: Preparing for the Future." The goal of the workshop was "to develop a common understanding of natural and cultural resource issues and to explore management approaches related to climate change in the Northeast." Its primary target audience was land managers. Climate change experts gave presentations and facilitated discussion. The stated outcomes were to have participants more fully understand the present and anticipated impacts from climate change on forested, ocean and coastal ecosystems, and be able to identify effective management approaches that include collaboration with other local, state and federal agencies. All of the Northeast Region Refuge Supervisors and planners attended, as did over 20 refuge field staff. Other future regional workshops are planned.

Recommendation #2: Manage for diverse conditions: This recommendation relates to developing sound wildlife management strategies under current conditions, anticipating unusual and variable weather conditions, such as warming, droughts and flooding.

Our proposed habitat management actions described in chapter 3 promote a diversity of healthy, functioning habitats in both the refuge's uplands and wetlands. Restoring and protecting the integrity of the refuge's shoreline and tidal wetlands is our highest management priority. We have identified monitoring elements, which will be fully developed in the IMP step-down plan, to evaluate whether we are meeting our objectives and/or to assess changing conditions. We will implement an adaptive management approach as new information becomes available.

Recommendation #3: Do not rely solely on historical weather and species data for future projections without taking into account climate change: This recommendation relates to the point that historical climate, habitat and wildlife conditions are less reliable predictors as climate changes. For example, there may be a need to adjust breeding bird survey dates if migratory birds are returning earlier to breed than occurred historically. A 3-week difference in timing has already been documented by some bird researchers.

We are aware of these implications and plan to build these considerations into our IMP so that we can make adjustments accordingly. Our results and reports, and those of other researchers on the refuge, will be shared within the conservation community.

Recommendation #4: Expect surprises, including extreme events: This recommendation relates to remaining flexible in management capability and administrative processes to deal with ecological “surprises” such as floods or pest outbreaks.

Refuge managers have flexibility within their operations funds to deal with emergencies. Other Regional operations funds would also be re-directed as needed to deal with an emergency.

Recommendation #5: Reduce non-climate stressors on the ecosystem: This recommendation relates to reducing human factors that adversely affect resiliency of habitats and species.

Similar to our response to #2 above, the objectives of our habitat management program are to protect the biological integrity, diversity and health of refuge lands. Objectives to enhance the refuge’s shoreline and tidal wetlands, and establish healthy, diverse native forests will help offset the local impacts of climate change.

Recommendation #6: Maintain healthy, connected, genetically diverse populations: This recommendation relates to the fact that small isolated populations are more prone to extirpations than larger, healthy, more widespread populations. Large tracts of protected land facilitate more robust species populations and can offer better habitat quality in core areas.

We will continue to work with our many conservation partners at the state and regional level to support and complement habitat restoration and land protection efforts.

Recommendation #7: Translocate individuals: This recommendation suggests that it may sometimes be necessary to physically move wildlife from one area to another to maintain species viability. However, it is cautioned that this tool has potential consequences and should only be used in severely limited circumstances as a conservation strategy.

We have no plans to translocate animals within the 15 year time frame of this CCP.

Recommendation #8: Protect coastal wetlands and accommodate sea level rise: This recommendation relates to actions that could ameliorate wetland loss and sea level rise, such as purchasing wetlands easements, establishing riparian and coastal buffers, restoring natural hydrology, and refraining from developments or impacts in sensitive wetlands and coastal areas.

Our responses to recommendation #2 and #6 above identify our objectives to work within the conservation community to protect shoreline and tidal marsh, maintain healthy native habitats, and support others’ protection of lands with high wildlife and habitat values.

Those actions notwithstanding, concerns with the impacts of sea level rise on the refuge and in the Chesapeake Bay can not be overstated. EPA estimates that with additional global warming and continued subsidence, sea level in the Chesapeake Bay area probably will rise another 8 inches by 2025, 13 inches by 2050, and 27 inches by 2100, compared with the level in 1990. Such a rate of sea level rise would be approximately double that of the preceding century. There is even a small risk—a 5 percent chance based on current computer models—that the sea will rise as much as 44 inches by 2100. For the past 5,000 years,

the average rate of sea level rise in Chesapeake Bay was approximately 3 feet per 1,000 years. During the 21st century, global warming could cause the Bay's level to rise at a rate closer to 3 feet per 100 years. Rapid sea level rise could be devastating for most of Chesapeake Bay's islands, including Eastern Neck Island, as well as its marshes and beaches. The loss of these habitats in turn would affect birds, fish, terrapins, and other wildlife. Salt marshes can keep up with moderate increases in sea level but may be drowned if the sea rises faster than sediments and peat can build up the marsh. In low-lying areas like the Eastern Shore, new marsh develops naturally as rising seas flood the land (US EPA, 2001)

The EPA modeling of potential sea level rise indicates that over the long-term there is a distinct possibility that a major portion of the marshes and some of the upland areas on the refuge would gradually disappear beneath the rising waters of the bay (US EPA, 2001). During the 15-year life of this CCP, however, we are hoping that the measures proposed under alternative B to protect and restore the refuge shoreline and tidal marshes would curtail that impact. In addition, as we describe in chapter 3 under "Actions Common to All of the Alternatives — Adaptive Management" we plan to employ an adaptive management approach to ensure we respond to new information or events. New models, tools or techniques would all be considered as we implement and evaluate our actions.

Recommendation #9: Reduce the risk of catastrophic fire: This recommendation acknowledges that fire can be a natural part of the ecosystem, but that climate change could lead to more frequent fires and/or a greater likelihood of a catastrophic fire.

Our plans to conduct prescribed burns to maintain grasslands, control invasive plants, and possibly to reduce fuel loading in overstocked forest stands would reduce the overall risk of a catastrophic event.

Recommendation #10: Reduce likelihood of catastrophic events affecting populations: This recommendation states that increased intensity of severe weather can put wildlife at risk. While the severe weather cannot be controlled, it may be possible to minimize the effects by supporting multiple, widely spaced populations to offset losses.

Our response to recommendations #2 and #6 above describes the actions we are taking to minimize this risk.

Recommendation #11: Prevent and control invasive species: This recommendation emphasizes the increased opportunities for invasive species to spread because of their adaptability to disturbance. Invasive species control will be essential, including extensive monitoring and control to preclude larger impacts.

Invasive species control is a major initiative within the Service. The Northeast Region, in particular, has taken a very active stand. In chapter 3, we provide detailed descriptions of our current and future plans on the refuge to control existing invasive plant infestations. We also describe monitoring and inventorying strategies to protect against any new infestations. We also plan to promote the refuge as a demonstration area to educate other landowners on techniques for controlling invasive plants. This effort expands the long-term effectiveness of our on-refuge program.

Recommendation #12: Adjust yield and harvest models: This recommendation suggests that managers may have to adapt yield and harvest regulations in

response to climate variability and change to reduce the impact on species and habitats.

We do not have plans for any significant harvest activities. Our monitoring program will include detecting population trends in focal species to alert us to any significant changes.

Regarding animal harvest through hunting programs, the refuge has a small deer and turkey hunting program. Both hunt programs are implemented in coordination with MD DNR, who set state-level non-migratory wildlife harvest targets consistent with maintaining healthy populations of those resident populations. Our program is well within their harvest recommendations.

Recommendation #13: Account for known climatic conditions: This recommendation states we should monitor key resources through predictable short-term periodic weather phenomenon, such as El Nino, to aid us in future management efforts.

We plan to develop a monitoring program that will help us evaluate our assumptions and success in achieving objectives, as well as help us make future management decisions. Any restoration activities or management actions will be carefully planned and their effectiveness monitored and documented so we can use this information in future management decisions.

Recommendation #14: Conduct medium- and long-range planning: This recommendation states that plans covering more than 10 years should take into account potential climate change and variability as part of the planning process.

This 15-year CCP addresses climate change with its emphasis on restoring and maintaining healthy, contiguous, diverse habitat areas, reducing human stressors on refuge lands, working with private landowners to improve the health and integrity of their lands, and supporting our conservation partners' efforts to pursue larger conservation connections and corridors with to enhance protected core areas. Our monitoring program and adaptive management strategies will also facilitate our ability to respond to climate change.

Recommendation #15: Select and manage conservation areas appropriately: This recommendation states that establishing refuges, parks and reserves is used as a conservation strategy to try to minimize the decline of wildlife and habitats in North America. Decisions on locating future conservation areas should take into account potential climate change and variability. For example, it is suggested that decisions on new acquisition consider the anticipated northward migrations of many species, or the northern portion of species ranges. Managers of existing conservation lands should consider climate change in future planning.

We do not propose to expand this refuge at this time; however, our education and outreach efforts, coupled with our land protection activities at Blackwater refuge and those of other land protection partners, will help implement this recommendation.

Recommendation #16: Ensure ecosystem processes: This recommendation suggests that managers may need to enhance or replace diminished or lost ecosystem processes. Manually dispersing seed, reintroducing pollinators, treating invasive plants and pests, are examples used.

While we plan to take an aggressive approach to treating invasive plants, we do not believe at this time there is any need to enhance or replace ecosystem processes. Further, none of our proposed management actions will diminish natural ecosystems processes underway. Should our monitoring results reveal

that we should take a more active role in enhancing or replacing those processes, we will reevaluate and/or refine our management objectives and strategies.

Recommendation #17: Look for new opportunities: This recommendation states that managers must be continually alert to anticipate and take advantage of new opportunities that arise. Creating wildlife conservation areas out of abandoned or unusable agricultural land, and taking advantage of industry interest in investing in carbon sequestration or restoration programs, are two examples cited.

Refuge staff have many conservation partners in the area which, in turn, are networked throughout the larger region. We hear about many opportunities for land protection or habitat restoration through that broad-based network. Our Northeast Region has field offices and a regional office that integrates the other Service program areas, including those that work with private entities. We have developed outreach materials, and make ourselves available to interested organizations and groups, to provide more detailed information on the Service and Refuge System missions, refuge goals and objectives, and partnership opportunities.

Recommendation #18: Employ monitoring and adaptive management: This recommendation states that we should monitor climate and its effects on wildlife and their habitats and use this information to adjust management techniques and strategies. Given the uncertainty with climate change and its impacts on the environment, relying on traditional methods of management may become less effective.

We agree that an effective and well-planned monitoring program, coupled with an adaptive management approach, will be essential to dealing with the future uncertainty of climate change. We have built both aspects into our CCP. We will develop a detailed step-down IMP designed to test our assumptions and management effectiveness in light of on-going changes. With that information in hand, we will either adapt our management techniques, or re-evaluate or refine our objectives as needed.

Relationship Between Short-term Uses of the Human Environment and Enhancement of Long-term Productivity

In this section we consider the relationship between local, short-term uses of the human environment and maintaining long-term productivity of the environment. By long-term we mean that the impact would extend beyond the 15-year planning horizon of this draft CCP/EA.

Under all of the alternatives, our primary aim is to maintain or enhance the long-term productivity and sustainability of natural resources on the refuge, in the Lower Chester River Basin, and for migratory birds and inter-jurisdictional fish and other far ranging species, across the whole range of each of the species. Short term human uses of the refuge are of secondary importance. We allow those uses only if they are compatible with the resource protection goals. The Service strives to protect Federal trust species and the habitats they depend on, as evidenced by the public use restrictions on access and prohibition of types of use other than foot traffic and non-motorized boating. Outreach and environmental education in each alternative would encourage visitors to be better stewards of our environment.

The dedication of certain areas for new trails, parking areas, and boating access facilities on the refuge represents a loss of long-term productivity on a certain few localized areas, but is not considered significant given the comparative refuge size.

In summary, we predict that all of the alternatives would contribute positively to maintaining or enhancing the long-term productivity of the environment.

Unavoidable Adverse Impacts

Unavoidable adverse effects are the effects of those actions that could cause significant harm to the human environment and that cannot be avoided, even with mitigation measures. There would be some minor, localized unavoidable adverse effects under all the alternatives. For example, there would be minor, short term, localized adverse effects of realigning the headquarters access road and prescribed burning for grassland maintenance and invasive plant control. There would continue to be property tax losses to the local community under all alternatives and increased visitation under all alternatives that could have unavoidable effects. However, none of these effects would rise to the level of significance. Furthermore, all of these impacts would be mitigated, so there would in fact be no significant unavoidable adverse impacts under any of the alternatives.

Potential Irreversible and Irretrievable Commitments of Resources

Irreversible commitments of resources are those which cannot be reversed, except perhaps in the extreme long term or under unpredictable circumstances. An example of an irreversible commitment is an action which contributes to a species' extinction. Once extinct, it can never be replaced.

In comparison, irretrievable commitments of resources are those which can be reversed, given sufficient time and resources, but represent a loss in production or use for a period of time. An example of an irretrievable commitment is the maintenance of grasslands to benefit grassland birds under alternatives A and B. If for some reason in the future grassland birds were no longer an objective, these would gradually revert to mature forest, or the process could be expedited with plantings.

Only a few actions proposed in the CCP would result in an irreversible commitment of resources. One is construction of the proposed new parking facilities. All alternatives propose that we continue to pursue this action.

The commitment of resources to maintain the wetlands is small compared to the benefits derived from the increased biodiversity. These wetlands provide nesting, foraging, and migrating habitat for many migratory bird species of conservation concern. They also benefit Refuge visitors by providing wildlife observation opportunities

Refuge-Specific Impacts: Summary of the Impacts of the Alternatives

Table 4.1 summarizes the benefits and adverse impacts of the alternatives.

Table 4.1. Summary impact comparison of the Eastern Neck Refuge CCP Alternatives.

	Alternative A Current Management	Alternative B Emphasis on Tidal Wetlands and Waterfowl (Service-Preferred Alternative)	Alternative C Emphasis on Tidal Wetlands and Forest Habitats
Air Quality	<p>Some air filtering and carbon sequestration benefits from continuing to protect over 800 acres of natural vegetated uplands, including 708.1 forest acres, and 858.8 acres of tidal marsh.</p> <p>Negligible adverse effects from particulate emissions from prescribed burning on up to 30.7 acres/year for grassland maintenance and up to 300 acres/year for invasive plant control. Negligible increase in emissions from staff vehicles and equipment and visitor vehicles.</p>	<p>Minimal increase in air filtering and carbon sequestration benefits from consolidating and reducing cropland acreage, increasing forest by 185.2 acres and restoring 107.8 additional acres of tidal marsh.</p> <p>Increased, but negligible, adverse effects from particulate emissions from prescribed burning on up to 40.3 acres/year for grassland maintenance and up to 500 acres/year of invasive plant control. Negligible increase in vehicle emissions from visitation increase.</p>	<p>Minor increase in air filtering and carbon sequestration benefits from allowing all uplands to succeed to 1,300 forested acres and restoring 107.8 additional acres of tidal marsh.</p> <p>Increased, but negligible, adverse effects from particulate emissions from prescribed burning on up to 500 acre/year of invasive plant control. Negligible increase in vehicle emissions from staff vehicles and from highest visitation increase.</p>
Impacts That Would Not Vary By Alternative			
<p>Regional air quality should not be adversely affected by any proposed refuge management activities. None of the alternatives would violate EPA standards; all three would be in compliance with the Clean Air Act.</p> <p>Visibility concerns due to emission-caused haze at the nearest Class I airshed, Brigantine Wilderness Area in New Jersey, would not be affected. Management actions and public uses at the refuge would contribute a negligible increment to overall Kent County emissions and it is highly unlikely that air emissions from the county would reach that Class I area. Brigantine Wilderness Area is more than 100 miles distant to the east.</p>			

	Alternative A Current Management	Alternative B Emphasis on Tidal Wetlands and Waterfowl (Service-Preferred Alternative)	Alternative C Emphasis on Tidal Wetlands and Forest Habitats
Water Quality and Aquatic Biota	<p>Continued benefits from maintaining existing breakwaters to protect shoreline and prevent long term loss of island integrity. Continued benefits from protection of the tidal marsh vegetation and SAV beds from maintaining natural vegetation buffers which filter runoff from cropland and other operations on the refuge.</p> <p>Best management farming practices (BMPs) on 557.1 acres would minimize the potential for nutrient and contaminant flows into the surrounding shallow water.</p> <p>Minimal risk of herbicide used in invasive plant control contaminating shallow water habitats; risk mitigated through proper application procedures and using only approved, low toxicity glyphosate and imazapyr.</p> <p>The predicted 10% increase in fishing, hunting, and non-consumptive activities over 15 years would elevate potential risk for contamination through runoff of petroleum products from roads, vehicles, and parking areas and from litter and trampling.</p>	<p>Increased benefits from expanding breakwater protection of shoreline and upgrading prevention of long term loss of island integrity. Increased benefits from additional restored tidal marsh acres and forest acres, both of which filter runoff from the refuge.</p> <p>Cropland operations reduced to 371.9 acres decreases potential for contamination from field runoff. Continued use of BMPs minimizes potential for nutrient and contaminant flows. Would more actively work with refuge partners to address water quality issues in the Lower Chester River Basin.</p> <p>Increased herbicide use on grasslands and invasive plants would cause minor increased risk for contamination of shallow water and SAV habitats.</p> <p>The predicted 15% increase in fishing, hunting, and non-consumptive activities would minimally increase potential for contamination through runoff of petroleum products from roads, vehicles, and parking areas, and from litter and trampling.</p>	<p>Increased breakwater benefits same as B.</p> <p>Eliminating cropland and grassland management would decrease risk for herbicide contamination of shallow water and SAV habitats. Increased forest acres would provide greatest filtering benefits among the alternatives.</p> <p>Limited control of invasive plants with herbicides and prescribed fire would have minimal potential to affect water quality.</p> <p>The predicted 20% increase in fishing, hunting and non-consumptive activities is highest among the alternatives. This level of use which is the highest increase of 3 alternatives would present a slightly increased potential above alternatives A and B for contamination of the surrounding shallow water through runoff of petroleum products from roads, vehicles, and parking areas and from litter and trampling.</p>
Impacts That Would Not Vary By Alternative			
<p>Pollutant levels from point and non-point sources elsewhere in the Lower Chester River Basin would not be affected by Service actions at the refuge. However, the refuge would continue to benefit water quality in the Bay by excluding development in this portion of the watershed and sustaining natural water filtering vegetation; serving as a demonstration area for best management farming and forestry practices; and, partnering with others for long-term water quality improvements.</p>			

	Alternative A Current Management	Alternative B Emphasis on Tidal Wetlands and Waterfowl (Service-Preferred Alternative)	Alternative C Emphasis on Tidal Wetlands and Forest Habitats
Socio-economics	<p>Would maintain role as the most important sanctuary and food source for migrating and wintering waterfowl in the Lower Chester River Basin thus sustaining the economic values of waterfowl hunting on adjacent lands in the Upper Eastern Shore.</p> <p>Minimal direct contributions to the local economy of Rock Hall and nearby small communities in terms of refuge purchases of goods and services and crop production.</p> <p>Would likely see a minimal increase in refuge visitor expenditures in local economy with predicted 10% increase in annual visitor numbers.</p>	<p>Cropland consolidation would minimally improve refuge's contribution as a sanctuary and food source for migrating and wintering waterfowl in the Lower Chester River Basin and sustain the economic values of waterfowl hunting on adjacent lands in the Upper Eastern Shore.</p> <p>Adding up to 3 permanent refuge staff would near the refuge minimally increase benefits to the local economy with respect to jobs, income, and purchase of goods and services.</p> <p>Road realignment construction work and work to upgrade refuge management infrastructure would also add expenditures to the local economy for labor, materials, and services.</p> <p>Would see expanded increase in refuge visitor expenditures in local economy with predicted 15% increase in annual visitor numbers. Minimal impact from crop production similar to Alternative A depending on continued cooperative farming.</p>	<p>Eliminating refuge croplands would substantially reduce our ability to provide sanctuary and food for migrating and wintering geese and some duck species. The economic values of waterfowl hunting on the Upper Eastern Shore would be adversely affected although the value as a sanctuary to other waterfowl in the Lower Chester River Basin would be maintained.</p> <p>Similar to alternative B, adding refuge staff would minimally increase benefits to the local economy with respect to jobs, income, and purchase of goods and services.</p> <p>Work to upgrade refuge management infrastructure would also add expenditures to the local economy for labor, materials, and services.</p> <p>Would see greatest increase in refuge visitor expenditures in local economy with predicted 20% increase in annual visitor numbers. Minimal loss to local economy from elimination of crop production.</p>
Impacts That Would Not Vary By Alternative			
<p>Regardless of which alternative we select, we would continue to make the same Refuge Revenue Sharing payments to Kent County. However, Kent County's economy is so large in comparison that these revenue sharing payments have minimal benefits to the county budget. Also, under all alternatives, refuge management jobs, income, and purchase of goods and services would minimally affect local economy. Direct benefits from refuge visitor expenditures in the local community would occur with all alternatives, but increases most under alternative C.</p>			

	Alternative A Current Management	Alternative B Emphasis on Tidal Wetlands and Waterfowl (Service-Preferred Alternative)	Alternative C Emphasis on Tidal Wetlands and Forest Habitats
Shoreline	<p>Although no additional shoreline protection planned, we would continue to voice our concerns about shoreline protection through partners and the media and respond to partner efforts to implement protection as funding and material sources become available to them.</p> <p>Provides the least amount of effort to pursue and implement shoreline protection projects. We would rely on other entities to initiate new protection efforts in the Bay. Would decrease our ability to quickly respond to erosion threats at any particular locations along the refuge shoreline.</p> <p>Maintaining designated access trails and use areas helps prevent damage to sensitive areas.</p>	<p>We would expand our shoreline protection over the next 15 years with 3 proposed new breakwater projects providing approximately 25,000 feet of new protection on our southern and southeastern shores.</p> <p>With predicted increase in visitor numbers, there is slightly increased potential for public gaining unauthorized access to unprotected sections of shoreline either from the land side or in watercraft. There might be minor damage to protective vegetation that could hasten localized erosion. Designated trail and access sites and increased outreach and law enforcement capabilities would help lessen chances of these impacts occurring.</p> <p>Proposed public use and biological monitoring would identify problem areas early and allow us to address them before any substantive effects result.</p>	<p>Expanded breakwater project benefits the same as alternative B. Allowing upland areas to succeed to forest cover would minimize the potential for access to unauthorized sections of the shoreline from the land side.</p> <p>Impacts from public uses similar to alternative B, only slightly elevated since we would expect an additional 5% annual visitors under alternative C.</p> <p>Use of increased outreach, law enforcement and monitoring to address impacts is similar to alternative B.</p>
Impacts That Would Not Vary By Alternative			
Regardless of which alternative we select, we would continue to maintain the off-shore breakwaters and on-shore armoring that currently protects a large portion of the refuge's western shoreline.			

	Alternative A Current Management	Alternative B Emphasis on Tidal Wetlands and Waterfowl (Service-Preferred Alternative)	Alternative C Emphasis on Tidal Wetlands and Forest Habitats
Tidal Marsh	<p>Continuing to protect 858.8 acres of tidal marsh and the refuge shoreline conserves marsh values, but improvements would be limited. We would continue the marsh restoration work in conjunction with the existing breakwater project and continue to treat <i>Phragmites</i> to restore the marsh to native species to the extent feasible. These provide direct benefits to affected tidal marsh.</p> <p>Some minimal risk of effects from Service activities in uplands from leaks or spills involving chemicals or petroleum products. Our leak and spill prevention and emergency clean-up procedures should ensure that such occurrences are rare and are addressed immediately, with short-term effects limited to the immediate location.</p> <p>Best management farming and forestry practices would continue to be implemented to minimize risk to tidal marsh and other wetlands.</p>	<p>Increased benefits to the tidal marsh habitat and marsh-dependent species compared to alternative A with proposed projects. Expanding shoreline protection projects to protect 25,000 additional feet of shoreline reduces erosive forces of tides and waves that also tend to erode the refuge marsh. In addition, would actively restore up to 107.8 acres of tidal marsh in the areas protected by these projects.</p> <p>Similar minimal risk from Service activities as described in alternative A. With new HQ road access planned during construction, but would result in only short-term, localized turbidity and no substantive habitat alteration or degradation would occur.</p> <p>As with alternative A, leak and spill prevention and emergency clean-up procedures should ensure that such occurrences are rare and effects limited to the immediate location. Also, adhering to best management farming and forestry practices would minimize risks.</p>	<p>Benefits would be similar to alternative B.</p> <p>Adverse effects would be similar to alternative B.</p>
Impacts That Would Not Vary By Alternative			
<p>Regardless of management alternative, we would continue to conserve the tidal marsh as a priority to buffer the erosive effects of tides and wave action and to protect habitat for fish, shellfish, and other aquatic species, as well as marsh birds and migrating and wintering waterfowl. The refuge believes that with the proper management, fishing and other conforming public uses would not result in any short or long-term impacts that would adversely affect the purpose of the refuge or the mission of the National Wildlife Refuge System. Adhering to best management farming and forestry practices would be a priority to minimize risk to tidal wetlands and Bay aquatic resources.</p>			

	Alternative A Current Management	Alternative B Emphasis on Tidal Wetlands and Waterfowl (Service-Preferred Alternative)	Alternative C Emphasis on Tidal Wetlands and Forest Habitats
Soils	<p>No significant adverse impacts on refuge soils from continuing current management. No major construction activities planned. Impacts confined to compaction and soil disturbance on unsurfaced access roads from staff using vehicles to engage in monitoring and management activities.</p> <p>Would continue prescribed burns to maintain grasslands or control invasive plant species, but would strictly adhere to burn plan prescriptions to avoid impacts.</p> <p>Cropland farming would continue on 557.1 acres, but we would follow best management farming practices.</p> <p>Mowing, herbicide use, and other management and administrative activities, especially activities off-road or trail, may lead to minor, localized soil impacts and disturbance, but would not be cumulatively significant.</p> <p>Expected 10% increase in visitation might increase risk of soil disturbance, such as hiking off designated trails, but is not a concern at present.</p>	<p>Cropland consolidation, HQ road realignment, and MSU construction might cause short term soil erosion and compaction impacts. Long term soil impacts of cropland farming would decrease because croplands would be reduced under this alternative.</p> <p>We would slightly increase annual burning acres to manage an additional 10 acres of grassland, and treat invasive plants as needed, thus impacts slightly higher than alternative A, but still minimal and localized.</p> <p>Other management and administrative activities and their impacts would be similar to alternative A.</p> <p>With predicted increase in visitor numbers, there is slightly increased potential for impacts caused by off trail travel. There might be minor damage to protective vegetation that could hasten localized erosion. Designated trail and access sites and increased outreach and law enforcement capabilities would help lessen chances of these impacts occurring.</p>	<p>Would be most beneficial alternative for soil restoration and protection because we would eliminate any potential for damage from cropland and grassland management activities. Impacts from farm equipment, mowers, herbicides, and other site disturbances would be virtually eliminated under this alternative. Emphasizing forest habitats would offer best protection to soils from erosion over the long-term.</p> <p>Replanting trees to restore forest may cause short-term soil disturbance, compaction and localized erosion depending on site conditions and site preparation methods. These would be minimal with use of best management practices. In the long term, establishment of native species would help restore and maintain soil productivity at these sites.</p> <p>Similar to alternative B, there would be some localized increase in soil impacts where public access and uses are enhanced under this alternative. Design and monitoring of these more intensive public use areas would militate against any potential for long-term impacts.</p>
Impacts That Would Not Vary By Alternative			
<p>The soils of Eastern Neck refuge are in good condition and would remain so under all management alternatives. We would continue to maintain vegetative cover that minimizes soil losses through erosion. We would continue to prohibit recreational activities such as ATV's or mountain biking, that would damage soils on the refuge. Hiking trails, boat launch sites, wildlife observation areas, parking areas and other high-use areas would continue to be well maintained to keep soil effects to a minimum. Any erosion problems would be noted during routine refuge monitoring and corrected as soon as feasible. Regardless of which CCP alternative we select, we would continue to use best management practices in all management activities that might affect refuge soils to ensure that we maintain soil productivity. Site conditions including soil composition, condition and hydrology would be the ultimate determinant of the wildlife management potential for any particular site on the refuge. No site would be managed in a manner inconsistent with its recognized potential.</p>			

	Alternative A Current Management	Alternative B Emphasis on Tidal Wetlands and Waterfowl (Service-Preferred Alternative)	Alternative C Emphasis on Tidal Wetlands and Forest Habitats
Forest Habitat	<p>Protection of 708.1 acres of forested upland under this alternative would benefit the habitat through long-term Service management and conservation.</p> <p>There would continue to be some minimal level of risk of loss or damage to forest vegetation involved with use of prescribed fire to reduce invasive plants. However, we would adhere to burn plan prescriptions to minimize impacts.</p> <p>Routine maintenance of roads and trails may result in the loss of individual trees, but we do not expect the number of trees felled would affect the quality or diversity of forest habitat present.</p>	<p>Forested habitat on refuge would increase through establishment of native tree species on some former croplands. Through best management forest practices and invasive plant control, we would enhance the health and vigor of these newly established stands. Over the long-term, forest habitats would result in less risk of an environmental impact from cultural and habitat management practices since less intervention would be necessary to sustain it.</p> <p>Localized tree cutting of forested field borders (about 17 acres) would result from consolidating adjacent crop fields and constructing new access road for HQ. However, integrity and habitat value of these forested borders is not as high as the larger less disturbed forested areas on the refuge. These border areas are heavily infested with invasive plant species and there is only a limited degree of forest regeneration possible in such narrow confines. The long term the loss of forest habitat value when these are removed would be minimal compared to the total acreage of new forest habitat that would be established in retired crop fields.</p>	<p>Would provide the greatest benefits to the refuge's forest habitats, compared to the other alternatives, by allowing all croplands and grasslands to grow into forest. Approximately 1,319.5 acres, nearly double the current cover, would eventually be forested, resulting in larger unbroken forested tracts. Expanded acreage and reduction in forest fragmentation would make the habitat more viable for migratory forest-dependent birds and other forest dwelling animals. Would also increase the habitat's capability to support natural processes.</p> <p>Some negligible risk that native forest community diversity may be adversely affected under alternative C. Allowing natural forest succession to proceed with minimal management may lead to greater risk from invasive plants and/or may lead to dominance by one or a few tree species. Over the long-term this could reduce the diversity of forest-dependent fauna on the refuge.</p>
<p align="center">Impacts That Would Not Vary By Alternative</p>			
<p>Wherever practicable, we would replace non-native plant species with native species to restore the ecological integrity of the refuge. Monitoring and controlling pests and invasive plants would benefit refuge forest habitat by preventing widespread tree loss and maintaining forest health. Regardless of which alternative is selected, we would use certain tools to help maintain, enhance or create wildlife habitat: replanting with native species, prescribed fire, mowing, and herbicides. The impacts of these methods were discussed previously in the section on soils. The alternatives would vary in terms of the extent and frequency of use of these management practices. An indirect long term impact is the potential for the increased number of visitors predicted to unintentionally introduce and/or spread invasive species. Once established, invasive plants can out-compete native forest plants, thereby altering habitats and impacting wildlife. The threat of invasive plant establishment would always be an issue, and would require annual monitoring, treatment and visitor education.</p>			

	Alternative A Current Management	Alternative B Emphasis on Tidal Wetlands and Waterfowl (Service-Preferred Alternative)	Alternative C Emphasis on Tidal Wetlands and Forest Habitats
Grassland Habitat	<p>Continuing to manage grasslands makes a minimal contribution to habitat diversity in the Bay area. Locally, refuge grasslands provides some benefits to migratory birds and butterflies</p> <p>There would continue to be some minimal level of risk of loss or damage to other vegetation involved with use of herbicides and prescribed fire to maintain grasslands. We would adhere to detailed burn plans to ensure that those risks remain low. Herbicides would be used only under strict application precautions to ensure that only the targeted plants are affected.</p>	<p>Benefits to grassland habitats stated under alternative A would increase with management of an additional 10 acres under alternative B.</p> <p>Best management practices would be followed for prescribed burns, mowing, and other practices that could impact grasslands and other adjacent vegetation. Long term management to promote quality grassland habitat would offset any such localized short-term adverse effects.</p>	<p>Benefits to grasslands habitat under alternative C would be eliminated since it would no longer be managed as grasslands.</p> <p>Existing grassland habitats would be managed to transition to forest. Some grassland may continue to exist as a minor component as a result natural disturbance, but it would no longer contribute to habitat diversity on the refuge or provide benefits to migratory birds and butterflies.</p>
Impacts That Would Not Vary By Alternative			
<p>Wherever practicable, we would replace non-native plant species with native species to restore the ecological integrity of the refuge. Regardless of which alternative is selected, we would use certain tools to help maintain, enhance or create wildlife habitat: replanting with native species, prescribed fire, mowing, herbicides. The impacts of these methods were discussed previously in the section on soils. The alternatives would vary in terms of the extent and frequency of use of these management practices.</p>			

	Alternative A Current Management	Alternative B Emphasis on Tidal Wetlands and Waterfowl (Service-Preferred Alternative)	Alternative C Emphasis on Tidal Wetlands and Forest Habitats
Waterfowl	<p>Migratory waterfowl would continue to be a management priority on the refuge. They would continue to benefit from maintenance of the refuge in general and from specific waterfowl conservation measures, including cropland management, MSUs and GTRs.</p> <p>Increasing refuge visitation under Alternative A may result in a minimal increase in human disturbance of waterfowl near trails or watercraft. Because most visitors understand the protection afforded by the Refuge and the Service would continue to provide educational materials and adequate signage, these instances should remain rare.</p> <p>Measures we would implement to control mute swans would directly benefit other waterfowl and wetland breeding birds in the short term by reducing these aggressive non-indigenous birds.</p>	<p>Among the alternatives, alternative B would provide the greatest benefits to waterfowl. We would expand our management to current and restored tidal marsh, increase management to 50.5 acres of MSU, and sustain 38 acres of GTRs for migrating waterfowl. We would consolidate farming operations to fewer, larger fields with the same production of foods but offering a higher level of security from predation.</p> <p>Similar to alternative A, measures we would implement to control mute swans by removal of adults, would benefit other waterfowl and wetland breeding birds by reducing these aggressive non-indigenous birds.</p> <p>Increasing refuge visitation may result in some minor increase in human disturbance of waterfowl near trails, at boating access points, or in watercraft. Because most visitors understand the protection afforded by the Refuge and the Service would continue to provide educational materials and adequate signage, these instances should remain rare.</p>	<p>Long term management of existing and potential restored tidal marsh would benefit migrating waterfowl to the same degree as alternative B.</p> <p>Similar to alternative B, measures we would implement to control mute swans would benefit other waterfowl and wetland breeding birds by reducing these aggressive non-indigenous birds.</p> <p>Allowing crop fields to succeed to forested habitats would eliminate the high calorie grains highly desired by migrating and wintering AP Canada geese, black ducks and other waterfowl. It would also reduce the attraction of the refuge to waterfowl as a safe haven during hunting season and from other human disturbances.</p> <p>As noted for alternative B, increasing refuge visitation under alternative C may result in some minor increase in human disturbance of waterfowl near trails, at boating access points, or in watercraft. Because most visitors understand the protection afforded by the Refuge and the Service would continue to provide educational materials and adequate signage, these instances should remain rare.</p>
	Impacts That Would Not Vary By Alternative		
	<p>Regardless of alternative our continued protection and management of refuge tidal marsh and uplands would benefit migratory and wintering waterfowl. These areas would remain undeveloped and almost wholly in native vegetation cover in the long term, thereby sustaining a reserve of migratory and wintering habitats in the Lower Chester River Basin that would otherwise likely be intensively developed. Mute swans would be controlled under all alternatives, reducing their impacts on waterfowl.</p> <p>Under all alternatives, public use would be managed through designating trails and access areas and through outreach, education and law enforcement to ensure there would be no short or long-term impacts to waterfowl at the refuge, especially during winter when birds are most vulnerable to disturbance.</p>		

	Alternative A Current Management	Alternative B Emphasis on Tidal Wetlands and Waterfowl (Service-Preferred Alternative)	Alternative C Emphasis on Tidal Wetlands and Forest Habitats
Shorebirds, Marsh Birds and Wading Birds	<p>Continued protection of existing tidal marsh and management of MSUs would benefit, shorebirds, marsh and wading birds by ensuring these habitats exist for the long-term.</p> <p>An increase in annual refuge visitation (10%) would minimally elevate the potential for impacts to wetlands and disturbance to shorebirds, marsh and wading birds. The potential for disturbance from refuge maintenance projects and staff using motor vehicles to monitor the MSUs and to maintain adjacent croplands would be negligible.</p> <p>No new construction projects are planned under Alternative A.</p>	<p>Protection of existing tidal marsh and planned restoration of an additional 107.8 acres, along with management of existing and 5 proposed MSUs, would benefit shorebirds, marsh and wading birds by ensuring these habitats exist for the long-term. Changes in MSU management, under alternative B, including the flooding and dewatering timing, would optimize use and benefits to these birds during migration.</p> <p>An increase in annual refuge visitation (15%) would minimally elevate the potential for impacts to these birds. The potential for disturbance from refuge maintenance projects and staff using motor vehicles as noted in alternative A would be slightly increased, but still predicted to be negligible.</p> <p>The refuge Headquarters Road realignment project has the potential to disturb birds in nearby MSUs, but construction timing would take into consideration the peak use times of these habitats by these species and mitigate accordingly.</p>	<p>Shorebirds, marsh birds, and wading birds would benefit with protection of existing tidal marsh, and the planned restoration of an additional 107.8 acres, similar to alternative B. Benefits to these birds from MSU management would be similar to alternative A.</p> <p>An increase in refuge visitation (20%) would elevate the potential for impacts to wetlands and disturbance to shorebirds, marsh and wading birds commensurately compared to alternative B. The potential for disturbance from refuge maintenance projects and staff using motor vehicles is less than alternative A since cropland management would be eliminated.</p> <p>There would be no refuge Headquarters Road realignment project, but facilities expansion projects at Tundra Swan Boardwalk and proposed car-top boat launch have the potential to disturb birds in the marsh and nearby MSUs. However, these projects would take into consideration the peak use times of these habitats by these species and mitigate accordingly.</p>
Impacts That Would Not Vary By Alternative			
<p>Regardless of alternative selected, the refuge would continue to provide breeding and migratory habitat for shorebirds, marsh birds, and wading birds, though the distribution and acreage of types would vary among alternatives. Visitors using the refuge for consumptive and non-consumptive wildlife related uses would continue to cause some minor level of disturbance of these birds at locations on the refuge where trails or boating or fishing access points are near habitats used by these birds. In addition to causing disturbance, visitors who are fishing may introduce litter and lead sinkers that may harm these birds. Disturbance impacts would be similar to those discussed above for other refuge users. In addition, no lead sinkers would be permitted to prevent lead poisoning to wading birds that use the HQ pond.</p>			

	Alternative A Current Management	Alternative B Emphasis on Tidal Wetlands and Waterfowl (Service-Preferred Alternative)	Alternative C Emphasis on Tidal Wetlands and Forest Habitats
Songbirds, Raptors, and Other Birds of Conservation Concern	<p>Continued benefits to upland bird species by managing for existing diversity on 708.1 acres of forest and 30.7 acres of grasslands over the long-term.</p> <p>Continuing the cropland management program on 557.1 acres would benefit not only wintering waterfowl but also neotropical migrants and raptors. Maintaining field borders would particularly benefit sparrow species. Continued farming would also benefit wild turkey.</p> <p>There would be short-term localized impacts to bird habitat and temporary displacement of birds from management practices such as mowing and prescribed burning for grassland management or herbicide treatments for invasive plant control. Trail maintenance activities would also cause negligible short-term, localized effects from disturbance. Impacts from visitor disturbance may increase minimally due to a general increase in refuge visitation.</p> <p>Turkey hunting results in direct harvest of individual turkey but harvest levels do not impact overall population viability on the island.</p>	<p>Benefits to forest and grassland birds increases under alternative B from increasing acreages on the refuge to 40.3 acres of grassland and 881.6 acres of forested habitat. Additional benefits to forest dependent birds would derive from enhancing forest diversity and reducing fragmentation by managing mature deciduous-mixed forest habitat with a diverse canopy structure and with at least 75 percent of the acreage in contiguous, unfragmented blocks of at least 25 acres of native forest, with at least two of those blocks exceeding 100 acres each.</p> <p>Habitat improvements, particularly control of invasive plants, would benefit birds in the longer term. Continued farming would also benefit wild turkey.</p> <p>Construction projects, such as refuge HQ road alignment would increase disturbance to landbirds and remove more acreage from natural habitat than alternative A.</p> <p>Visitor disturbance would increase because of the increase in visitation and the increased access from new and improved refuge amenities. However, these effects would be more than offset by the overall protection afforded these birds on refuge lands. Impacts on turkey from hunting are the same as described in alternative A.</p>	<p>Benefits would increase over those described for alternative B for forest-dependent songbirds and raptors since grasslands and croplands would transition to mixed-hardwood forest. We predict an increase in forest breeding bird populations because forest acreage would nearly double from the current acreage.</p> <p>On the other hand, allowing grasslands, croplands, and hedgerows to succeed to forest cover would likely eliminate birds that require those habitats for all or a portion of their survival requirements. Grassland birds in particular would be adversely affected under alternative C because their habitat would not be maintained on the refuge except in a small naturally-disturbed sites or local grassed areas maintained for other reasons. These birds may disappear from the refuge. Because grassland is a minor portion of the refuge habitats, loss of grassland bird breeding or stopover sites on the refuge would constitute a negligible effect to the population of those species in the area. Removal of all croplands would reduce habitat values for some songbirds, raptors, and wild turkeys that forage in those fields.</p> <p>Impacts on turkey from hunting are the same as described in alternative A</p>
Impacts That Would Not Vary By Alternative			
<p>Protection and management of current refuge lands would generally benefit forest birds that use the refuge to breed, winter, or migrate through the refuge. The bald eagle was recently removed from the Federal list of threatened and endangered species. Nevertheless, we would continue to protect nesting bald eagles and their habitat on the refuge under all alternatives. There are currently seven nesting pairs and the refuge would continue to monitor the nests and breeding activities and prohibit the public from disturbing them. There would be a potential for disturbance to nesting birds from refuge maintenance activities, or from prescribed burning or use of herbicides to control invasive plants or maintain grasslands or by construction projects. These methods would displace birds from treated locations, and if any active nests are present, they could be damaged or destroyed. The impacts would be minor, highly localized and short-term with no threats to regional bird populations in terms of adult mortality or breeding success. Treated habitats would be improved in the long term and this would benefit bird populations over the long-term.</p>			

	Alternative A Current Management	Alternative B Emphasis on Tidal Wetlands and Waterfowl (Service-Preferred Alternative)	Alternative C Emphasis on Tidal Wetlands and Forest Habitats
Other Native Wildlife: Mammals, Reptiles & Amphibians	<p>Mammalian, reptile, and amphibian species would continue to benefit as we manage a diversity of refuge habitats for the benefit of wildlife.</p> <p>Mowing and prescribed burning would continue to occasionally injure or kill individual small mammals in grassland management units.</p> <p>Hunter harvest of deer and cooperative farmer trapping of raccoons and ground hogs would result in direct mortality of individual animals. We would remove problem animals through lethal means only when necessary. Outreach and education programs would continue to be used to inform the general public and nearby landowners of the need for and ecological soundness of hunting and animal damage control measures.</p>	<p>Mammals, reptiles and amphibians would continue to benefit from managing a diversity of refuge habitats under alternative B.</p> <p>Mowing and prescribed burning would continue to occasionally injure or kill individual small mammals, reptiles or amphibians in grassland management or in invasive plant control.</p> <p>Increased visitation under alternative B would slightly increase the possibility of adverse encounters between humans and mammalian wildlife.</p> <p>Any potential for hunting or trapping impacts and controversy would likely be similar to those under alternative A.</p>	<p>Under alternative C, forest dependent wildlife species would be favored because grasslands and croplands would transition to forest. Forest tracts on the refuge would be larger and more contiguous, including an almost unbroken forested buffer around the entire perimeter of the island.</p> <p>Populations of mammals that inhabit grassland habitats and on croplands, such as the meadow vole and woodchuck, would decline as grasslands and croplands are allowed to grow to later successional vegetation. These species are abundant in the farmlands and other grassed areas in the Region so there would be no significant impacts to the species off the refuge.</p> <p>Increased visitation under alternative C would result in slightly greater risk of impacts than those described under alternative B.</p> <p>Any potential for hunting or trapping impacts and controversy would likely be similar to those under alternative A.</p>
Impacts That Would Not Vary By Alternative			
<p>Regardless of which alternative we select, we would continue to provide a natural landscape with a diversity of habitats to support the mammalian, amphibian, and reptile species found here. Controlled deer hunting helps keeps the deer population within the carrying capacity of the habitat. Managed and unmanaged wetlands, ponds, and vernal pools provide breeding habitats for amphibians. Native vegetation provides cover and breeding substrate for reptiles. Monitoring for and controlling infestations of invasive gypsy moths if they occur would benefit forest wildlife.</p> <p>Refuge habitat management activities such as mowing and using prescribed fire would likely kill individual small mammals, such as mice, moles, and shrews, as well as any amphibians or reptiles using those fields and cause temporary disturbance or displacement of others, but there would be no significant mortality or loss of local populations because these actions would be done on a rotational basis meaning no major habitat components would be completely changed in any one given year. Mammals at the Refuge would continue to experience some minimal level of human disturbance from Refuge staff and from visitors, regardless of alternative. Disturbance to non-target mammal species is likely to occur during hunting seasons.</p> <p>Deer hunting would continue to be allowed on the refuge under all alternatives so direct mortality to deer from hunting would continue. However, deer are abundant across their range and in many areas, including Maryland's Eastern Shore; deer degrade habitat values due to their overabundance. Nevertheless, we would continue to adhere to State seasons which account for species populations and trends so there would be no long term threat to deer populations from deer hunting on the Refuge. Members of the public who consider deer hunting to be unacceptable would continue to have the basis to voice those concerns.</p> <p>Contaminants that might run-off into refuge MSU, GTR, or vernal ponds from cropland operations or roads and parking areas could adversely affect amphibians. Monitoring and corrective measures would continue to be taken to ensure contaminated run-off does not become a problem.</p>			

	Alternative A Current Management	Alternative B Emphasis on Tidal Wetlands and Waterfowl (Service-Preferred Alternative)	Alternative C Emphasis on Tidal Wetlands and Forest Habitats
Invertebrates	<p>Maintaining 30.7 acres of grasslands under alternative A would benefit native butterfly species. Maintenance of MSUs would benefit dragonflies and damsel flies.</p> <p>Burning for grassland habitat management would cause short term impacts, killing numbers of insects and other invertebrates on burn sites, but these areas would begin to recover rapidly and no long-term effects would occur.</p>	<p>Management of up 40.3 acres of grasslands would increase benefits to native butterfly species. Expanding management to more than 80 acres of GTRs and MSUs would increase benefits to some species of aquatic insects and invertebrates.</p> <p>Burning for grassland habitat management would cause similar short term impacts, to insects and other invertebrates on burn sites, as under alternative A.</p>	<p>Refuge protection under alternative C would generally benefit invertebrates by maintaining native forested habitats under Service protection and management although species that prefer grasslands, old fields, or croplands would be eliminated over the long-term.</p> <p>There would be no prescribed burning for grassland habitat management. Burning would be limited to invasive species control which may cause short term impacts, killing numbers of insects and other invertebrates, on burn sites but these areas would begin to recover rapidly and no long-term effects would occur.</p>
Impacts That Would Not Vary By Alternative			
<p>Regardless of which alternative we select, we would continue to manage our current refuge lands to support a diversity of ecosystem components including a wide array of insects, spiders, earthworms, aquatic arthropods, and other invertebrates. Invertebrates are critical food items for insectivorous birds such as warblers, bats, moles, shrews, raccoons, fish and a number of other refuge wildlife species. Except for gypsy moth control, we would use no application of chemical insecticides on the refuge for insect control in any of our habitats. Chemicals that may be used are specific for gypsy moth and would not affect other lepidopterans. Improvements in water quality and tidal marsh protection and restoration efforts would benefit the shallow water habitats surrounding the refuge and benefit aquatic invertebrate populations.</p> <p>There would continue to be some losses of invertebrates, for example, ants and earthworms, from equipment used in prescribed burning and mowing to maintain grasslands and control invasive plants. These would be minimal, highly localized, and short-term and no invertebrate species populations would be affected.</p>			

	Alternative A Current Management	Alternative B Emphasis on Tidal Wetlands and Waterfowl (Service-Preferred Alternative)	Alternative C Emphasis on Tidal Wetlands and Forest Habitats
Biological Diversity, Biological Integrity, and Environmental Health	<p>No major habitat or management activity changes planned under alternative A so existing diversity, integrity and health would be maintained.</p> <p>Best management forestry and farming practices would continue to be implemented to protect soils and water quality. See additional discussions above on soils and water impacts. We anticipate some temporary effects from our management activities, but most of those activities would not influence any features of biological integrity, biological diversity, and environmental health.</p> <p>Our continued emphasis on protecting species of concern and Federal trust resources conserves those components of diversity in the refuge area. Our work with partners to conserve these species and habitats extends those benefits to other sensitive species, and maintain ecosystem processes and environmental health.</p>	<p>Beneficial impacts are similar but greater in magnitude than alternative A because of the increased emphasis on protecting the refuge shoreline and tidal marsh on which so many species and resources depend. Partnerships to conserve Bay resources would be expanded to make an even greater contribution to the regional protection of diversity, integrity and health.</p> <p>Habitat management programs would exceed existing agricultural and forestry best management practices, but otherwise benefits would be similar to alternative A. In addition, intensively managed croplands would be reduced by 185.2 acres and would transition to forest, increasing native diversity. Invasive plant control would continue to be a priority.</p> <p>We anticipate some temporary effects from our management activities, but most of those activities would not influence any features of biological integrity, biological diversity, and environmental health.</p>	<p>Beneficial impacts would be increased over alternatives B and C with regards to integrity and health. The transition of 557.1 acres in croplands to native forest is one of the principle reasons. Diversity of habitats on the refuge, however, would be diminished with the loss of croplands and grasslands.</p> <p>Management emphasis to protect and improve water quality, protect the shoreline and tidal marsh, control invasive plants, and work with partners to have a greater influence on conserving Bay resources, would result in benefits similar to alternative B in those regards.</p>
	Impacts Regardless of Alternative		
	<p>There are sufficient differences in management activities proposed and habitat changes expected to occur among the alternatives that would invariably result in at least minimal differences in biological diversity, integrity and environmental health. Regardless of those differences we would continue to strive for the highest degree of these ecological measures achievable given staffing, funding, and other constraints within each of the alternatives.</p>		

	Alternative A Current Management	Alternative B Emphasis on Tidal Wetlands and Waterfowl (Service-Preferred Alternative)	Alternative C Emphasis on Tidal Wetlands and Forest Habitats
Archaeological and Historic Resources	<p>Continued Service protection of the refuge would benefit cultural resources by ensuring that none of the substantial impacts related to development for other uses would affect known or as yet undiscovered cultural and historic resources on those lands.</p> <p>Refuge visitors may inadvertently or intentionally damage or disturb these sites. We would manage these resources to protect sites, structures, and objects of importance for scientific study, public appreciation and socio-cultural use by complying with Section 106 of the National Historic Preservation Act of 1966, as amended, promoting academic research on, or relating to, refuge lands, adding Antiquities Resource Protection Act (ARPA) language to appropriate public use materials to warn visitors about illegal looting, and by maintaining law enforcement personnel trained in ARPA enforcement.</p>	<p>There would be increased benefits to cultural, archeological, and historic resources under alternative B because of increased partnering efforts to locate and protect these resources. The expansion of shoreline protections under the alternative will also guard important resources from erosion.</p> <p>There is a slightly increased risk to cultural and historic resources from the predicted increase in visitation. However our increased outreach and law enforcement capabilities planned under alternative B would enhance our ability for that protection.</p>	Same benefits and impacts as described under alternative B.
Impacts That Would Not Vary By Alternative			
Areas with potential to contain cultural or historic resources would be protected regardless of which alternative we select. We would take all necessary precautions to ensure that no sites or structures on National Historic Register would be impacted. This document will be sent to the MD SHPO for 106 compliance and we will also continue to do Section 106 compliance for all individual projects.			

	Alternative A Current Management	Alternative B Emphasis on Tidal Wetlands and Waterfowl (Service-Preferred Alternative)	Alternative C Emphasis on Tidal Wetlands and Forest Habitats
Public Use Management— Wildlife Observation and Photography	<p>These public use programs would not change from what exists today under alternative A.</p> <p>Increasing development pressure and concomitant demand for outdoor recreational opportunities in Kent County and other parts of the Bay region would likely lead to an increase in user conflicts and enforcement issues on the refuge if no improvements or additional opportunities are provided.</p>	<p>Benefits to public users would increase with the proposed enhancements to public use infrastructure in a few areas and in existing programs. The quality of interpretive and outreach materials would improve with emphasis on promoting a conservation ethic.</p> <p>The predicted increase in visitation, and increased compatible wildlife-oriented opportunities for consumptive and non-consumptive uses would combine to increase the risk of human-wildlife conflicts and habitat damage. There would likely be more instances of trespassing in unauthorized areas of the refuge. There would be a greater likelihood of minor injuries or accidents by trail users. There may be associated parking issues during times of heavy use when lots fill and people attempt to park in unauthorized locations.</p> <p>Our plans for increased visitor services expertise, outreach, and law enforcement capabilities planned under alternative B would enhance our ability to deal with these conflicts.</p>	<p>Benefits and potential impacts would be similar but slightly increased over alternative B. Some additional infrastructure planned, including the Tundra Swan Boardwalk on the north end and a proposed car-top boat launch on the south end would provide additional opportunities but could also increase the risk to resource and create additional inter-user conflicts. However, as with alternative B, our plans for increased visitor services expertise, outreach and law enforcement capabilities planned under alternative C would enhance our ability to deal with these conflicts.</p>
	Impacts That Would Not Vary By Alternative		
	<p>Regardless of alternative would continue to provide public wildlife observation and photography opportunities. We would continue to maintain refuge facilities including the refuge headquarters, the foot trails and water trail and parking areas, observation platforms, and kiosks. Public use may be affected temporarily during prescribed burning activities to manage the grasslands or control invasive plants, but the impact should be minimal because most burn project areas are small, burning is usually done during seasons of low visitation, and weather conditions required for burns to occur would ensure that smoke disperses readily.</p>		

	Alternative A Current Management	Alternative B Emphasis on Tidal Wetlands and Waterfowl (Service-Preferred Alternative)	Alternative C Emphasis on Tidal Wetlands and Forest Habitats
Public Use Management— Environmental Education and Interpretation	We would be able to provide only a minor increase in efforts to support environmental education and interpretation opportunities under Alternative A.	<p>Our plans for increased visitor services expertise and outreach under alternative B would enhance our ability to develop quality programs.</p> <p>Our increased efforts to support environmental education and interpretation opportunities on the refuge would likely increase visitation on the refuge and result in minor disturbance to wildlife that accompanies virtually all public uses. Because the visitation would be in larger groups the wildlife disturbance might be higher than it would be with individuals or smaller groups. However, these groups would be led by educators or other sponsors so would not contribute to disturbance in unauthorized areas of the refuge.</p> <p>Our plans for increased staff would better allow us to better deal with potential conflicts.</p>	Alternative C would result in the same impacts as alternative B.
Impacts That Would Not Vary By Alternative			
Regardless of the alternative we select, we would continue to provide opportunities for environmental education and interpretation on the refuge. We anticipate that the Friends of Eastern Neck refuge, volunteers, regional educational institutions, and researchers would continue to help us support these activities on the refuge because of the importance of the resources on the refuge, our location on the Chesapeake Bay, and the proximity of the major Baltimore-Washington DC metropolitan areas.			
Public Use Management— Hunting	Deer and turkey hunters would be constrained to hunt in only certain areas of the refuge. However, the agricultural fields might be locations where hunters would be more successful in terms of effort required to harvest a deer or turkey because movement through the fields is less impeded by forest undergrowth.	As under alternative A, deer and turkey hunters would be constrained to hunt in only certain areas of the refuge. Reduction in the acreage and consolidation of the agricultural operations to larger fields might somewhat reduce the extent of locations where hunters would be more successful in terms of effort required to harvest a deer or turkey.	Reversion of all but certain management sites to forest would increase opportunities for successful deer and turkey hunting on the refuge because fewer constraints would be placed on hunters as to refuge areas that would be closed and succession stages of forest would likely be more productive in term of increased deer and turkey populations.
Impacts That Would Not Vary By Alternative			
Regardless of alternative, we would continue to provide deer hunting opportunities for the same number of adult hunters (600) and youth hunters (50) as well as 2 days for the youth turkey hunt.			

	Alternative A Current Management	Alternative B Emphasis on Tidal Wetlands and Waterfowl (Service-Preferred Alternative)	Alternative C Emphasis on Tidal Wetlands and Forest Habitats
Public Use Management— Fishing and Boating	<p>Anglers and boaters would continue to benefit under this alternative from our maintaining fishing and boating opportunities on the refuge. Continued protection of the tidal marsh, and shoreline, and partner efforts to address water quality and SAV problems in the Lower Chester River Basin would help sustain the fishing and crabbing resource base.</p> <p>Fishing and boating activities that have the potential to damage refuge resources may occur more frequently under this alternative because there would be no expanded efforts to restrict access locations where resource damage is being done. There would be no additional efforts to designate restricted access locations, close sites, or provide general information.</p>	<p>We would not make any major facilities improvements under alternative B, but we would enhance our recreational boating and fishing programs through enhanced outreach and informational materials. We would also promote a conservation ethic by providing monofilament line-disposal units at all fishing access areas.</p> <p>Increased marsh and shoreline protection, and increased partnership efforts to address water quality and SAV problems in the Lower Chester River Basin would enhance our current measures to sustain the fishing and crabbing resource base.</p> <p>Resource protection may lead to additional constraints on fishing and boating opportunities. We would establish designated shoreline and boat fishing access locations where resource damage is a concern and some sites may be closed periodically to reduce resource damage, or minimize conflicts with other habitat management activities. Notification of closures would be posted on the refuge website and on signs located at the refuge entrance and tract parking areas at least 48 hours prior to its closure.</p> <p>Our plans for increased visitor services expertise, outreach, and law enforcement capabilities planned under alternative B would enhance our ability to deal with these conflicts and enforcement issues.</p>	<p>In addition to the increased informational program under alternative B, alternative C would provide increased opportunities for fishing and boating. We would extend the Tundra Swan Boardwalk for fishing and add a car-top boat launch.</p> <p>Increased efforts to protect the tidal marsh and shoreline, and increased partnership efforts are similar to alternative B.</p> <p>We plan the same staffing additions under alternative B which would enhance our capabilities at outreach and enforcement.</p>
	Impacts That Would Not Vary By Alternative		
	<p>Under all the alternatives we would continue to permit fishing and crabbing from the Tundra Swan Boardwalk, Ingleside Recreation Area, and Bogles Wharf. Canoeists and kayakers would have the use of the water trail under all alternatives.</p> <p>Resource protection would in every instance override interests of fishermen and boaters. The refuge marshes would continue to be off-limits to boaters, no landings in the marsh would be allowed. Fishing would continue to be restricted to only those locations where refuge regulations permit it and signage so indicates. The open waters of the tidal marsh are State waters so boaters would continue to be subject to State of Maryland regulations for boating and fishing in the tidal waters of the Bay and Chester River.</p>		